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SELECTED WATER RESOURCES ABSTRACTS

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NOVEMBER 1984

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

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The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management ond Budget through September 30, 1985.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationaliy owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey, MS 421
Reston, VA 22092

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SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

DEPENDENCE OF RELATIONSHIP BETWEEN INHERENT AND APPARENT OPTICAL PROPERTIES OF WATER ON SOLAR ALTITUDE,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
J. T. O. Kirk.
Limnology and Oceanography, Vol. 20, No. 2, p 350-356, March, 1984. 4 Fig, 14 Ref.

Descriptors: *Optical properties, *Water properties, Solar radiation, Monte Carlo Techniques, Natural waters, Photons, Light penetration.

A computer simulation study using the Monte Carlo calculation procedure has been carried out to determine in what way the relationships between the apparent and the inherent optical properties of natural waters are affected by the angle of incidence of the photons on the surface. With the particular normalized volume scattering function used in these simulations, the vertical attenuation coefficient for downward irradiance at the midpoint of the euphotic zone can be expressed as a function of the absorption and scattering coefficients and the cosine of the incident photons just below the surface. As the direction of the incident light departs increasingly from the vertical, the vertical attenuation coefficient for downward irradiance at the midpoint of the euphotic zone increases but becomes progressively less responsive to increases in scattering at constant absorption. The irradiance reflectance just below the surface at all angles of incidence increases linearly with the ratio of the backscattering coefficient to the absorption coefficient. It is now clear that the angle of the incident photons on the surface materially influences the relationship between the apparent and inherent properties of natural waters. The dependence on angle of incidence fortunately takes a comparatively simple form and the expressions given here make it possible to quantitatively relate the apparent to the inherent optical properties for any solar altitude. These expressions could also be used to explore the relationships between inherent and apparent optical properties for any specific nonparallel incident light field. The incident light can be apportioned into a set of angular intervals and the equations applied to each angular flux in turn. (Baker-IVI)
W84-04393

2. WATER CYCLE

2A. General

PRELIMINARY APPRAISAL OF THE HYDROLOGY OF THE STIGLER AREA, HASKELL COUNTY, OKLAHOMA,
Geological Survey, Oklahoma City, OK. Water Resources Div.
M. V. Marcher, T. L. Huntzinger, J. D. Stoner, and S. P. Blumer.
USGS Water Resources-Investigations Report 82-4099, 1983. 37 p, 7 Fig, 15 Tab, 15 Ref.

Descriptors: Strip mines, Strip mine wastes, Mine drainage, Coal mines, Water quality, *Oklahoma, Stigler, Taloka Creek, Haskell County.

In the Stigler area water in bedrock, which consists of shale, siltstone, and sandstone, is under artesian conditions. Because the rocks have minimal permeability, well yields probably are less than 5 gallons per minute. Ground water is commonly a mixed cation-bicarbonate type with dissolved solids ranging from about 200 to 2,500 milligrams per liter. No relationship between water chemistry and well depth of geographic distribution is apparent. Taloka Creek had a mean dissolved-solids concentration of 72 milligrams per liter upstream of the mine area and 1,323 milligrams per liter downstream. Concentrations of some toxic metals in Taloka Creek exceeded Primary Drinking Water limits during mining, but they have not exceeded the limits since mining ceased. Potential hydrologic effects of strip mining include (1) additional water storage in strip-mine ponds, (2) changes in rock permeability and ground-water storage, (3) changes in runoff and streamflow characteristics, (4) changes in drainage patterns, and (5) changes in the chemical quality and sediment loads of streams. (USGS)
W84-04267

SNOWMELT RUNOFF AND EROSION ON IOWA LOESS SOILS,
Agricultural Research Service, Council Bluffs, IA.
R. G. Spomer, and A. T. Hjelmfelt, Jr.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 4, p 1109-1111 and 1116, July-August, 1983. 4 Fig, 1 Tab, 5 Ref.

Descriptors: *Soil erosion, *Snowmelt, *Loess, *Iowa, Gully erosion, Rill erosion, Sheet erosion, Sediment yield.

If snowmelt runoff erosion is significant in western Iowa, it should be demonstrable on the loess soils at Treynor, IA. The research watersheds at Treynor have been gaged since 1964 with winter records of baseflow and runoff. Since 1967 many of the snowmelt runoff events have been sampled to provide sediment yield for field and gully erosion. Based on the 14 years of data, some snowmelt runoff can be expected every year, and it will exceed 10% of the total runoff about one out of every three years. Sheet-rill erosion resulting from snowmelt is not important in this loess soils region. Average annual sheet-rill erosion produced by snowmelt runoff was 0.3 t/ha or less and less than one percent of the average annual sheet-rill erosion. Annual gully erosion from snowmelt runoff may occasionally be of consequence. When long-term average annual values are considered, gully erosion due to snowmelt is not an important part of the average annual gully erosion. Sheet-rill and gully erosion sediment concentrations varied with time of season. Sediment concentrations were small during mid-winter snowmelt runoff events and increase with late winter snowmelt runoff. (Moore-IVI)
W84-04455

USING CROP MODELS FOR MANAGEMENT: IMPACT OF WEATHER CHARACTERISTICS ON IRRIGATION DECISIONS IN SOYBEANS,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
D. P. Swaney, J. W. Mishoe, J. W. Jones, and W. G. Boggess.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 6, p 1808-1814, November-December, 1983. 4 Fig, 5 Tab, 13 Ref. USDA-ARS grant CR-806277-02-0.

Descriptors: *Crop models, *Weather patterns, *Irrigation, *Soybeans, Simulation analysis, Model studies, Economic aspects, Profit, Evapotranspiration, Crop yield, Benefits, Irrigation programs.

Crop simulation models that respond to daily weather data are being developed to assist within-season decision making. A soybean crop model was implemented to evaluate real-time irrigation decisions. The sensitivities of these decisions and of resulting profit to current season weather data, short-term weather forecasts, and assumptions about future weather were investigated for three separate seasons. The analysis indicated that actual rainfall data prior to each decision date were essential. There were increases in net profit of 2 to 3% when actual potential evapotranspiration data were used prior to each decision date instead of historical averages. The use of average temperature and radiation decreased profit by only 1 to 2%. These results suggest that savings in real-time weather data collection may be realized for practical applications of crop models for scheduling irrigations in Florida. Future weather and management conditions had a large impact on the irrigation schedules and the net profit simulated by the model. Therefore, reliable short-term precipitation forecasts coupled with location-specific precipitation probability distributions for the remainder of the season were needed for applying the soybean crop model to make real-time irrigation decisions. (Murphy-IVI)
W84-04486

GEOTHERMAL RESERVOIR SIMULATION USING NONEQUILIBRIUM THERMODYNAMICS,
Princeton Univ., NJ.
V. V. Nguyen, and G. F. Pinder.
Society of Petroleum Engineers of AIME, Vol. 23, No. 4, p 613-622, August, 1983. 8 Fig, 2 Tab, 12 Ref.

Descriptors: *Geothermal reservoirs, *Simulation, *Nonequilibrium thermodynamics, Thermodynamics, Geothermal studies, Simulation analysis, Mathematical model, Model studies, Mathematical equations, Hydrothermal flow, Hydrothermal studies.

All numerical simulators of geothermal reservoirs depend on an accurate representation of the thermodynamics of the steam/water system. An alternative view on nonequilibrium thermodynamics is presented. A phenomenological interpretation of the evolution of a steam/water system is proposed from a nonequilibrium mixture perspective. This type of thermodynamic behavior is structurally stable on the basis of catastrophe theory and therefore offers an unorthodox alternative approach to the simulation of geothermal reservoirs. Use of this approach in a one-dimensional (1D) finite-difference simulator yields results that can be compared with a traditional numerical scheme. (Murphy-IVI)
W84-04536

INTERACTIVE WATER QUALITY SIMULATION IN A REGIONAL FRAMEWORK: A MANAGEMENT ORIENTED APPROACH TO LAKE AND WATERSHED MODELING,
International Inst. for Applied Systems Analysis, Laxenburg (Austria).
K. Fedra.
Ecological Modelling, Vol. 21, No. 4, p 209-232, March, 1984. 6 Fig, 3 Tab, 20 Ref. Austrian Research Foundation grant 3905.

Descriptors: *Water quality, *Simulation, *Management planning, *Lake models, *Model studies, Hydrologic models, Computer models, Computer programs, Computers.

A phosphorus-based water quality simulation model for a shallow lake/reed system (Neusiedlersee, Austria) has been coupled with a series of heuristic, process oriented models describing the physical and socio-economic catchment of the lake. Built into an interactive, modular decision support system's framework, which includes simple database management, interactive video graphics, and linguistic output formats, the programs are designed for the simulation and evaluation of regional development, i.e, agricultural landuse, industry, tourism, wastewater treatment, and perceived lake water quality. Special emphasis is put on communication and display through a friendly man-machine interface, including linguistic statements for the description of lake water quality. (Author's abstract)
W84-04671

RESULTS OF THE UNESCO INTERNATIONAL HYDROLOGICAL PROGRAM (ERGEBNISSE DES INTERNATIONALEN HYDROLOGISCHEN PROGRAMMS DER UNESCO),
United Nations Educational, Scientific and Cultural Organization, Berlin (German D.R.). International Hydrological Programme.
S. Dyck, and P. Losel.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 3, p 95-98, March, 1983. 12 Ref.

Descriptors: *Hydrology, *East Germany, *International Hydrological Program, Water management, Research priorities.

An important part of international cooperation in hydrology consists of the German Democratic Re-

public's (GDR's) participation in two UNESCO programs: the International Hydrological Decade (IHD) from 1965 to 1974 and the International Hydrological Program (IHP). In contrast to IHD, IHP emphasizes the relationship between human activity, water resources, and the environment. At the UNESCO-sponsored International Conference on Hydrology in August 1981 in Paris, it was determined that of 67 IHP-1 (1975-80) projects, 54 were completed; some of these which proved to be of special scientific and practical value were Hydrological Parameters for Water Projects, Hydrological Aspects of Dry Spells. Changes in the Hydrological Regime as a Result of Human Activity, and Socioeconomic Aspects of Urban Hydrology. The main goal of IHP-1 was to enable individual countries to quickly solve their water problems through international cooperation in research and practice. Projects in which the GDR participated include the development and improvement of methods to calculate water balances and their elements, forecasting and simulation of drainage formation in catchment areas and of flow and transport of matter in surface waters, development and use of stochastic simulation techniques to intensify water management in river basins, management of ground water resources. The Paris conference drew up a plan for a third phase of IHP (1984-89), the theme of which will be 'Hydrology and the Scientific Principles of the Rational Management of Water Resources for Economic and Social Development.' (Gish-IVI)
W84-04782

2B. Precipitation

THE WEATHER OF '83; A YEAR OF WORLDWIDE EXTREMES, FLOODS AND DROUGHTS,
National Environmental Satellite, Data, and Information Service, Washington, DC. Climate Assessment Branch.
D. LeComte.
Weatherwise, Vol. 37, No. 1, p 8-19, February, 1984. 10 Fig.

Descriptors: *Floods, *Drought, El Nino Event, Weather patterns, Rainfall, Storms, Jet stream.

The year 1983 brought extremes of weather conditions including severe droughts, heavy rains, extreme heat, and unseasonable cold - the culmination of the El Nino event. Extreme cold and the worst drought since 1936 hit the United States. The worst flooding of the century struck Ecuador, northern Peru, and large areas of Brazil, Paraguay, and Argentina. The 1982-1983 El Nino event, perhaps the greatest oceanic-atmospheric perturbation ever recorded, was justly blamed for many of the year's weather disasters. El Nino was a contributing factor to the intense north Pacific cyclonic vortex aloft which drove storms onto the North American continent. Additionally, it was probably a factor in the strong west-to-east jet stream which contributed to flooding and severe local storms affecting the United States Gulf coast states and the northwestern Caribbean in the winter and spring. (Baker-IVI)
W84-04193

SEASONAL CHANGES IN THE DISTRIBUTION OF RAINFALL OVER THE GREAT DIVIDING RANGE: GENERAL TRENDS,
Saint David's Univ. Coll., Lampeter (Wales). Dept. of Geography.
G. N. Summer.
Australian Meteorological Magazine, Vol. 31, No. 2, p 121-130, June, 1983. 5 Fig, 18 Ref.

Descriptors: *Rainfall, *Seasonal variation, *Great Dividing Range, Topographic, Rainfall area, Wind, New South Wales, Australia.

Daily rainfall linkages based on the strength of product-moment correlation coefficients are used to indicate general rainfall areas around the Great Dividing Range in New South Wales. The considerable seasonal change in the scale of rainfall occurrence associated with times of increased incidence of disturbances associated with the westerlies in the cooler half of the year and with tropical easterlies in late summer is indicated, particularly for April and May, and February respectively. Outside these times however, topographic factors emerge as important controls on the distribution of daily rainfalls. The Great Dividing Range itself is an important climatic divide in the cooler part of the year but in the summer the Hunter Valley is seen to form the center of an important rainfall area, although this feature becomes masked in February by the higher incidence of more general rainfall in that month. Further subdivisions show that combinations of certain official forecasting areas provide logical rainfall units. (Author's abstract)
W84-04280

A NEW METHOD FOR ESTIMATING THE SPATIAL DISTRIBUTION OF MEAN SEASONAL AND ANNUAL APPLIED TO THE HUNTER VALLEY, NEW SOUTH WALES,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
M. F. Hutchinson, and R. J. Bischof.
Australian Meteorological Magazine, Vol. 31, No. 3, p 179-184, September, 1983. 6 Fig, 2 Tab, 20 Ref.

Descriptors: *Spatial distribution, *Seasonal rainfall, *Hunter Valley, *New South Wales, Empirical analysis, Rainfall, Isohyet maps, Isohyets, Model studies, Prediction.

Isohyet maps so far constructed for the Hunter Valley reflect a progression of methods, from small data sets subjectively analyzed, to more explicit methods applied to larger data sets. An empirical analysis of the spatial distribution of long-term mean seasonal and annual rainfall in the Hunter Valley for the period 1901 to 1975 is presented. Isohyet maps have been derived, using a recently developed method, from Laplacian smoothing spline surfaces fitted to rainfall data at 203 stations. The surface fitting method represents a substantial improvement over previously available subjective, least squares polynomial and weighted interpolation methods. The smoothing spline surfaces are functions of latitude, longitude and elevation with the degree of data smoothing determined by minimizing the generalized cross validation (GVC). The method does not require prior standardization of short-term means to long-term means, affords error estimates and allows testing of the validity of the fitted model. The fitted rainfall surfaces estimate long-term mean annual rainfall at any point in the valley with a percentage root mean square predictive error of 9.2% and estimate long-term mean seasonal amounts at any point with percentage root mean square predictive errors ranging from 11.9% in winter to 18.2% in summer. (Murphy-IVI)
W84-04281

NUTRIENTS IN PRECIPITATION COMPONENTS FOR PINE AND OAK FORESTS IN KUMAUN HIMALAYA,
Kumaun Univ., Naini Tal (India). Dept. of Botany.
P. C. Pathak, and J. S. Singh.
Tellus, Vol. 36B, No. 1, p 44-49, February, 1984. 6 Tab, 26 Ref.

Descriptors: *Nutrients, *Precipitation, *Pine, *Oak, *Forests, *Kumaun Himalaya, Chemistry of precipitation, Cycling nutrients, Litter, Rainfall.

Nutrients primarily move from the canopy in litterfall to the forest floor, where they are subsequently leached by percolating water and released from the organic matter by decomposition. Concentrations and inputs of certain nutrients in precipitation of pine and oak forests in Kumaun Himalaya were quantified. The mean concentration of nutrients was higher in throughfall and stemflow than in rainfall in open gauges. Among the nutrients, the leachability of K from the canopy was greatest and that of N lowest. The net gain of nutrients (kg/ha/yr) from the canopy was higher in oak forests, except for P and followed the order: K > Ca > Mg > N > P. Precipitation and throughfall inputs play a significant role in the nutrient cycling of these forests. (Murphy-IVI)
W84-04347

THE INFLUENCE OF DROUGHT ON THE FISH AND INVERTEBRATE POPULATIONS OF AN UPLAND STREAM IN WALES,
Severn-Trent Water Authority, Birmingham (England).
I. G. Cowx, W. O. Young, and J. M. Hellawell.
Freshwater Biology, Vol. 14, No. 2, p 165-177, April, 1984. 6 Fig, 3 Tab, 36 Ref.

Descriptors: *Droughts, *Invertebrates, Population dynamics, Streams, Wales, Fish, Ecosystems.

The exceptionally dry summer of 1976 presented an opportunity to assess the impact of drought on the fauna of an unregulated stream in Wales. The highest temperature was recorded during July of 1976 at Afon Dulas, recording 26.5 degrees C. The lowest temperature for the area was -1 degrees C. Diurnal fluctuations were as large as 10 degrees C. The total number of macroinvertebrates varied from 1808/sq m in September of 1976 to 7412/sq m in August of 1977. Two main effects of the drought were observed: an initial reduction in abundance during the drought and a change in community structure in the following year, probably through impaired reproduction. The only detrimental effect of the drought on the fish fauna was the elimination of the 1976 year class of young salmon, probably due to prolonged high water temperature. The trout population showed no unusual reduction in numbers as a result of the drought. (Baker-IVI)
W84-04372

STOCHASTIC SIMULATION OF DAILY RAINFALL FOR AUSTRALIAN STATIONS,
Melbourne Univ., Parkville (Australia). Dept. of Civil Engineering.
R. Srikanthan, and T. A. McMahon.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 3, p 754-759 and 766, May-June, 1983. 2 Fig, 8 Tab, 17 Ref.

Descriptors: *Rainfall, *Australia, *Stochastic process, *Simulation, Model studies.

Rainfall is an important weather variable, and it directly affects other variables such as soil moisture, maximum and minimum temperature, and evaporation. The objective of this study was to simulate daily rainfall sequences for Australia to use as inputs to weather, crop and hydrologic models. Daily rainfall data from 12 rainfall stations were selected to cover Australian rainfall conditions. Two stations were chosen from each of the six climatological zones. Four existing models were applied to generate daily rainfall data. All four models reproduced for all the stations the annual mean within the 95% confidence limits, but yielded smaller annual standard deviations than the corresponding historical values. None of the models reproduced satisfactorily the maximum daily rainfall. A model using transition probability matrices is developed to generate daily rainfall sequences for Australian conditions. The transition probability matrix method with the Box-Cox transformation for the largest state is found to be a suitable procedure to generate daily rainfall data throughout Australia. For twelve Australian stations, it preserves the daily as well as monthly and annual characteristics of the rainfall. (Moore-IVI)
W84-04437

RAINFALL CHARACTERISTICS AND THEIR RELATION TO SPLASH EROSION,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
S. W. Park, J. K. Mitchell, and G. D. Bubenzer.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 3, p 795-804, May-June, 1983. 9 Fig, 6 Tab, 23 Ref.

Descriptors: *Rain, *Rainfall intensity, *Splash erosion, Mathematical models, Terminal velocity,

Fall velocity, Drop size, Air temperature, Soil erosion.

This study involves the mathematical development of both analytical relationships for raindrop size distributions and terminal and fall velocities of raindrops. From the above relationships, storm energy and momentum parameters were simulated and then related statistically to rainfall intensity. A shifted log-normal function defines raindrop size distribution data from various regions very well. The parameters for shifted log-normal functions are closely related to rainfall intensity. The variations of the parameters with different regions appear to be very small. The number of drops contained in a rainfall is proportional to the square root of rainfall intensity. Rainfall intensity can adequately define the physical characteristics of rainfall. Terminal velocity simulated from the drag coefficient relationship was very close to the observed data. The velocity can vary significantly with ambient temperature. Fall velocity of a drop, before its terminal velocity, can be accurately determined from a buoyance and drag force relationship, and can be defined as a function of fall height and terminal velocity. Storm energy and momentum relationships were derived and expressed as a function of rainfall intensity. The values vary significantly with ambient temperature. Splash erosion rates were related to rainfall parameters and were defined as a function of rainfall momentum and number of drops. The splash erosion model can be expressed as a power function of rainfall intensity. The exponent of the model varies with soil type. (Moore-IVI)
W84-04443

A SIMPLIFIED TECHNIQUE FOR MEASURING RAINDROP SIZE AND DISTRIBUTION,
Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
J. D. Eigel, and I. D. Moore.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 4, p 1079-1084, July-August, 1983. 8 Fig, 45 Ref. NSF grant CME8105641.

Descriptors: *Rain, *Drop size, Photography, Simulated rainfall, Distribution, Oil method.

A simple technique for measuring raindrop size and distribution is presented. This technique, the Oil Method, has the advantage of being a direct measurement technique that requires no calibration and no special equipment except a camera. The Oil Method is based on the premise that water droplets suspended in a less dense but more viscous fluid assume a near perfect spherical shape due to the surface tension forces and the pressure distribution about the drops. The collection medium is a mixture of STP oil treatment and heavy mineral oil in a 100 mm diameter, 15 mm deep disposable petri dish. The photographic method adopted is the dark-field illumination technique. The photographic images were projected onto a smooth paper screen and measured. The enlargement factor was determined from a metric scale photographed with the petri dish. Drop sizes ranging from less than 0.1 mm to over 4.75 mm have been successfully measured useing this methiod. The technique was found to be easy to use both in the laboratory and in the field. The Oil Method has been used to determine the characteristics of simulated and natural rainfall. (Moore-IVI)
W84-04451

PROCEDURE FOR DEVELOPING DESIGN HYETOGRAPHS FOR SMALL WATERSHEDS,
Nigeria Univ., Nsukka. Dept. of Agricultural Engineering.
G. O. Chukwuma, and G. O. Schwab.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 5, p 1386-1389, September-October, 1983. 5 Fig, 1 Tab, 12 Ref.

Descriptors: *Hyetographs, *Temporal distribution, *Rainfall distribution, *Coshocton, *Ohio, Statistical methods, Sample size, Small watersheds.

A study of the time-distribution of 43 years of rainfall records for the growing season (April through September) revealed that about 40% of the storms at Coshocton, Ohio, were of type A (advanced) pattern. About 20% of the storms were of type C (intermediate) pattern. Sample-size rainfall analysis showed that variance decreased with increase in sample size. A sample of 50 storms was considered an adequate size for the storms studied. An equation derived for estimating sample size can be used to establish a representative pattern for a specified confidence interval. A statistical procedure (the bootstrap method) was followed to develop six rainfall temporal patterns of 50% probability: two advanced (types A and B), two intermediate (types C and D), and two delayed (types E and F). The procedure could be applied at other locations. The procedure for developing rainfall patterns using local data will yield results that reflect the rainfall characteristics of the location rather than a wide area of application. (Moore-IVI)
W84-04462

WINTER PRECIPITATION CATCH BY HEATED TIPPING-BUCKET GAGES,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
For primary bibliographic entry see Field 7B.
W84-04476

RAINFALL-ELEVATION RELATIONSHIPS IN THE WILSON CREEK EXPERIMENTAL WATERSHED,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
I. C. Goulter.
Canadian Journal of Civil Engineering, Vol. 11. No. 1, p 121-127, March, 1984. 5 Fig, 8 Ref.

Descriptors: *Rainfall, *Elevation, *Wilson Creek Experimental Watershed, Annual rainfall, Net rainfall, Manitoba escarpment, Rainfall variation, Topography, Upflow enhancement, Terrain analysis, Wilson Creek, Riding Mountain National Park, Manitoba, Canada.

The rainfall patterns in the Wilson Creek Experimental Watershed in Riding Mountain National park are analyzed. The rainfall-intensity-duration-frequency maps for Canada reveals that there is a significant effect on the precipitation patterns along the escarpment. Since this watershed lies on the Manitoba Escarpment there is a relatively sudden change in elevation across the watershed. The average annual rainfall is plotted against station elevation and against distance of the rainfall stations from the National Park boundary. Two distinct trends were observed. The average annual rainfall increases significantly from the bottom to the top of the escarpment. The average annual rainfall also levels off very quickly as the relatively flat plateau at the top of the escarpment is reached. No carry-over effects from terrain-induced upflow enhancement were observed. (Murphy-IVI)
W84-04552

OPTIMAL ESTIMATION OF THE AVERAGE AREAL RAINFALL AND OPTIMAL SELECTION OF RAIN GAUGE LOCATIONS,
Katholieke Univ. Leuven (Belgium). Lab. d'Automatique et d'Analyse des Systems.
G. Bastin, B. Lorent, C. Duque, and M. Gevers.
Water Resources Research, Vol. 20, No. 4, p 463-470, April, 1984. 11 Fig, 9 Tab, 10 Ref.

Descriptors: *Optimization, *Areal precipitation, *Rain gages, *Forecasting, Kriging, Mathematical equations, Rainfall intensity, Variogram model.

A simple procedure for the real-time estimation of the average rainfall over a catchment area is proposed. The estimation of such areal rainfall is an important step in many hydrological applications, such as evaluation of hydraulic balances, management of surface water resources, or real-time forecasting of river flows. The rainfall is modeled as a two-dimensional random field. The average areal rainfall is computed by a linear unbiased minimum variance estimation method (kriging) which requires knowledge of the variogram of the random field. A time-varying estimator for the variogram which takes into account the influences of both the seasonal variations and the rainfall intensity is proposed. The average areal rainfall estimator has been implemented in practice. The application to real data in two river basins in Belgium is illustrated. One of the by products of the procedure is that it yields a simple method for the selection of 'the most imformative' rain gauges among a set of existing ones, or for the selection of an optimal location to install additional rain gauges. (Murphy-IVI)
W84-04570

THE USE OF RADAR FOR HYDROLOGICAL MEASUREMENTS (MESURES HYDROLOGIQUES PAR RADAR),
Toulouse-3 Univ. (France). Lab. d'Aerologie.
H. Sauvageot.
La Houille Blanche, Vol. 5/6, p 329-340, 1983. 6 Fig, 36 Ref.

Descriptors: *Radar, *Precipitation intensity, Rain gages, Remote sensing, Hydrometeorology, Precipitation, Meteorological data collection.

Radar can be used as a quantitative hydrological sensor by interpreting meteorological echoes in terms of precipitation intensity. Promising results have been obtained from numerous tests based on this principle. The method is first presented on the basis of knowledge concerning the properties of precipitation and diffusion of the radar's electromagnetic waves by hydrometeors. Factors affecting the quality of the radar measurements are examined. A few examples of the functional relationships between the radar reflectivity factor and typical precipitation magnitudes are given. After separately examining measurement of precipitation by radar and by use of the rainfall network at ground level the author goes on to study the quality of measurements accessible to configurations which combine these two methods with a view to optimizing the accuracy of the results on the basis of the characteristics of the network and the techniques used to adjust the radar measurements with the help of data from ground level raingages. (Author's abstract)
W84-04645

THE ROLE OF DOPPLER RADAR IN THE STUDY OF PRECIPITATION (UTILITE DU RADAR DOPPLER DANS L'ETUDE DES PRECIPITATIONS),
Centre de Recherches en Physique de l'Environnement, Issy-les-Moulineaux (France).
P. Amayenc.
La Houille Blanche, Vol. 5/6, p 349-358, 1983. 6 Fig, 27 Ref.

Descriptors: *Doppler radar, *Precipitation, Remote sensing, Radar, Hydrometeorology, Air masses, Air-water interfaces, Meterological data collection.

During the last decade the Doppler radar has become a popular instrument for studying precipitation. The operating principle of the Doppler radar is recalled showing that, in addition to the power of the echo received, as in the case of conventional radar, it also can measure the radial velocity of cones in each field observed. The three conventional methods of using the Doppler radar for scientific purposes are then obtained. For each method, the principle together with recent modifications is described and physical quantities obtainable are illustrated by significant experimental results. The methodology of vertical shooting is examined whereby data on the vertical air speed and granulation of precipitation at the radar zenith can be recorded. Described are the conical speed method with one radar and the use of networks with two or more radars. The latter make it possible to observe the three-dimensional dynamics of air movement within a given precipitation system. Briefly indicated are recent operational applications based on rapid recognition of typical signals in reflectivity and radial velocity pictures which are provided with numbers and displayed on a color screen. They are basically used for short-term forecasting of violent and dangerous phenom-

ena (severity of near thunderstorms, tornadoes, gust fronts, turbulent zones). Two possible future developments expected over the next few years are also mentioned: the rapid sweep Doppler radar and the Airborne Doppler radar. (Murphy-IVI)
W84-04646

THE USE OF RADAR FOR FLOOD WARNING AND FORECASTING IN THE CRITICAL BASINS OF THE VEZERE AND CORREZE (LE RADAR ET LA PLUIE. APPLICATION A L'ANNOUNCE ET A LA PREVISION DES CRUES DANS LES BASSINS CRITIQUES DE LA VEZERE ET DE LA CORREZE),
Service Hydrologique Centralisateur du Bassin de la Garonne, Toulouse (France).
J.-P. Dupouyet.
La Houille Blanche, Vol. 5/6, p 387-392, 1983. 8 Fig.

Descriptors: *Radar, *Flood forecasting, *Vezere basin, *Correze basin, Flood plain management, Flood data, Flood profiles, Remote sensing, Precipitation intensity, Precipitation, Depth-area-duration analysis, Meteorological data collection, Hydrometeorology.

In order to alleviate the effects of rapid flooding of the Vezere and its tributary, the Correze, and to reduce the warning delay for the local population, the Central hydrological office for the Dordogne basin has used radars to test several methods whereby a relationship can be established between rain-gauge recordings and corresponding radar echoes. The experimental approach adopted appears suitable for forecasting rainfall and it is feasible for meteorological radars to effectively complete a conventional rain-gauge network. (Author's abstract)
W84-04647

THE USE OF RADAR AS AN AID TO QUANTITATIVE ESTIMATION OF PRECIPITATION. FORECASTING SUDDEN FLOODS IN MARTINIQUE (LE RADAR COMME AIDE A L'ESTIMATION QUANTITATIVE DES PRECIPITATIONS. PREVISION DES CRUES ECLAIRS EN MARTINIQUE),
Service Meteorologique Metropolitain, Le Bourget (France).
M. Le Quentrec.
La Houille Blanche, Vol. 5/6, p 393-398, 1983. 5 Fig.

Descriptors: *Radar, *Precipitation, *Flood forecasting, Flood data, Meteorological data collection, Hydrometeorology, Remote sensing, Telemetry, Martinique.

Joint use of radar telemetered rain-gauges and the conventional methods of a meteorological center which offers the advantage of working round the clock and being equipped with rapid warning systems has been tested with encouraging results on a basis of less than 100 sq km where reaction time is only a few hours. (Author's abstract)
W84-04648

CALIBRATION OF A METEOROLOGICAL RADAR FOR MEASURING PRECIPITATION. INITIAL RESULTS IN THE PARIS REGION (CALIBRATION D'UN RADAR METEOROLOGIQUE POUR LA MESURE DES PRECIPITATIONS. PREMIERS RESULTATS EN REGION PARISIENNE),
Centre National de la Recherche Scientifique, Marseille (France). Inst. de Mecanique des Fluides de Marseille.
J. D. Creutin, G. Delrieu, and Ch. Obled.
La Houille Blanche, Vol. 5/6, p 421-429, 1983. 7 Fig, 1 Tab, 5 Ref.

Descriptors: *Radar, *Calibrations, *Precipitation intensity, *Paris, Comparison studies, Meteorological data collection, Hydrometeorology, Rain gages, Rainfall intensity, Remote sensing, France.

Quantitative estimation of precipitation using meteorological radar is of interest to hydrologists. The hourly and daily data were used from the Dammartinen-Goele radar and a recording rain-gage network to present an initial approach to the problems of radar compared with an interpolation technique (Spline) which uses recording-gage networks only. Hourly comparisons taken at random (53 stations) between radar hyetographs and rain-gage recordings have made it possible to highlight several problems encountered in radar measurement (the importance of the Z-R (Marshall-Palmer) relationship, ground echoes, masking effects, distance effects on the radar, uniform calibration procedures) and to derive criteria concerning the choice of a minimum, representative calibration network. Initial tests were conducted to validate random radar measurement (with uniform, regionalized calibration by a sub-network (64 stations) with three days of uninterrupted operation of the radar and a dense network of rain-gages (270)). For these three days only the regionalized calibration technique gave results equivalent to those from a conventional (Spline) interpolation method using the calibration sub-network only. Only systematization of the calibration and validation procedures described to other rain spells and for a more extensive network of recording rain-gages can lead to definite conclusions. (Murphy-IVI)
W84-04649

2C. Snow, Ice, and Frost

JAKOBSHAVNS GLACIER DRAINAGE BASIN: A BALANCE ASSESSMENT,
National Aeronautics and Space Administration, Greenbelt, MD. Lab. for Atmospheric Sciences.
R. A. Bindschadler.
Journal of Geophysical Research, Vol. 89, No. C2, p 2066-2072, March 10, 1984. 6 Fig, 3 Tab, 18 Ref.

Descriptors: *Jakobshavns Glacier, *Catchment areas, Glaciers, Glaciohydrology, Glaciology, Glacial drift, Glacier balance, Glacier surges, Greenland.

Maximum and minimum estimates are made of the drainage basin feeding the Jakobshavns Glacier by using surface elevation maps derived from Seasat altimetry. Benson's (1962) net balance measurements are used to calculate the balance flow within the basin. Comparisons of the balance flux at the terminus with estimates of actual flux suggest the basin is in overall equilibrium or slightly thickening. This agrees with measurements along the nearby EGIG traverse. Balance velocities accelerate rapidly within 100 km of the coast. Further upstream, balance velocities are consistent with both measured velocities along the EGIG traverse and calculated deformation velocities. It is estimated that Jakobshavns Glacier discharges between 4.8 and 7.6% of the annual net balance over Greenland and drains between 3.7 and 5.8% of the ice sheet area. (Author's abstract)
W84-04297

SPRING BREAKUP AND FLUSHING OF AN ARCTIC LAGOON ESTUARY,
Alaska Univ., Fairbanks. Geophysical Inst.
J. B. Matthews, and W. J. Stringer.
Journal of Geophysical Research, Vol. 89, No. C2, p 2073-2079, March 20, 1984. 6 Fig, 1 Tab, 13 Ref.

Descriptors: *Ice breakup, *Arctic lagoon, *Estuaries, Snowmelt, Floodwaters, Satellite technology, Flushing, Salinity, Saline-freshwater interfaces, Simpson Lagoon, Beaufort Sea, Kuparuk River, Egg Island Channel.

Simpson Lagoon is a shallow body of water separated from the Beaufort Sea by a chain of low-lying barrier islands. Narrow channels are found between the barrier islands, one of which, the Egg Island Channel, is a major connection between the lagoon and the Beaufort Sea. The Kuparuk River produces great quantities of springtime floodwaters which overflow the still-frozen lagoon. This paper examines the relationships between these floodwaters and the character of the water within the lagoon. Measurements of temperature, salinity, sea level, and currents have been made in Egg Island Channel during 1978 and 1979. Meltwater from the Kuparuk River was observed on satellite images to overflow the 2-m-thick bottomfast ice of the lagoon in late May and early June. These floodwaters flush saline (greater than 40%) water out the 5-m deep channel and replace it with freshwater at 0 degrees C. Analysis of satellite images for several years shows that overflow occurs on May 31 with a standard deviation of 8 days. Sea level rose 64 cm above mean at peak flood in 1978. Subsequently, channel waters warmed to 8 degrees C in late June and were flushed by cold (approximately 0 degrees C), saline (approximately 24%) water from the Beaufort Sea in mid-July. Flooding in 1979 was anomalously early, providing additional insight into the flushing process. The return of seawater to the channel is due to wind-driven currents following the clearing of bottomfast ice in the lagoon. Satellite image analysis shows that ice-free conditions occur by July 10 with a standard deviation of 8 days. (Author's abstract)
W84-04298

ENVIRONMENTAL ISOTOPE CONTENT, GEOCHEMISTRY AND GENESIS OF ICE LENSES (PALSEN) IN NEW QUEBEC PEAT BOGS (CANADA) (COMPOSITION ISOTOPIQUE, GEOCHIMIE ET GENESE DE LA GLACE EN LENTILLES (PALSEN) DANS LES TOURBIERES AU NOUVEAU QUEBEC (CANADA)),
Paris-11 Univ., Orsay (France). Lab. d'Hydrologie et de Geochemie Isotopique.
L. Dever, C. Hillaire-Marcel, and J. Ch. Fontes.
Journal of Hydrology, Vol. 71, No. 1-2, p 107-130, March 15, 1984. 11 Fig, 5 Tab, 35 Ref.

Descriptors: *Sedimentation, *Geochemistry, *Isotropy, *Ice lenses, *Peat bogs, *Quebec, *Canada, Hudson Bay Ground ice, Ice formation, Dendrochronology.

Sedimentological, geochemical and isotopic (O-18, H-2, H-3) data for samples cored in peat bogs from eastern Hudson Bay profiles were established on four palsen. Cored profiles varies from 5 to 8 m; their summit culminates 2-3 m above the drainage level of the peat bog. The peat bog began to develop ca. 3650 + or - 100 B.P. on top of Tyrell sea clays. The ice content varies from 10% to 100% and averages at 50% in most of the profiles. Tritium contents as high as 200 T.U. are occasionally observed. They indicate inputs of recent meteoric waters. O-18 contents (ca. - 14.5 0/00 vs. SMOW) are in agreement with this interpretation inasmuch as they reflect the freezing (with approximately 3 0/00 enrichment in O-18) of the last 20 years' precipitation (mean annual temperature approximately equal to 4 degrees C). Abnormally high H-2 excesses (up to 77% above the usual relationship d = delta(H-2)-8deltaO-18) characterize some ice layers. They are interpreted as an effect of partial changes in phase (solid-liquid-vapor) of water, especially within the snow cover and further transfer of residual vapor through discontinuous ice profiles. Dendrochronological controls indicate a recent growth of ice lenses ca. 1850-1870 A.D. These lenses decayed during the first half of the 20th century, then they increased again since the 1950 thermal optimum. (Author's abstract)
W84-04303

ESTIMATION OF THE MASS OF LARGE SNOW AVALANCHES,
National Research Council of Canada, Vancouver (British Columbia). Div. of Building Research.
P. A. Schaerer, and B. B. Fitzharris.
Canadian Journal of Civil Engineering, Vol. 11, No. 1, p 74-81, March, 1984. 4 Fig, 3 Tab, 11 Ref.

Descriptors: *Avalanches, *Mass, Snow accumulation, Snow cover, Snow depth, Mathematical equation, Model studies, Prediction, Frequency, Design, Water equivalent, Rogers Pass, Canada.

When roads, railways, ski lifts, buildings, powerlines, or bridges are planned in areas exposed to snow avalanches, questions arise about maximums to be expected and how frequently they will occur. Estimating the size and return period of a design avalanche is somewhat similar to predicting the

magnitude and frequency of floods. The mass of avalanches was investigated using two series of observations made at Rogers Pass in Western Canada. Large avalanches occur once in 3-25 years at each avalanche path, and their mass greatly exceeds that of annual maximum avalanches. Standard extreme-value frequency distributions cannot be applied. An empirical predictive equation for the mass of large avalanches is presented that takes into account the 30-year maximum water equivalent of the snow in the avalanche path, surface area of the catchment, and incline of the starting zone. Observed avalanches with an apparent return interval of 100 years or greater had masses close to the predicted values. (Murphy-IVI)
W84-04551

INSOLATION TOPOCLIMATES AND POTENTIAL ABLATION IN ALPINE SNOW ACCUMULATION BASINS: FRONT RANGE, COLORADO,
Indiana Univ. at Bloomington. Dept. of Geology.
G. A. Olyphant.
Water Resources Research, Vol. 20, No. 4, p 491-498, April, 1984. 6 Fig, 4 Tab, 31 Ref.

Descriptors: *Insolation, *Topoclimates, *Ablation, *Snow accumulation basins, *Front Range, *Colorado, Topography, Snowmelt, Snow accumulation, Climates, Climatic data, Alpine regions, Cloud cover.

Cirques are a fundamental hydrologic unit in alpine areas because they constitute the primary snow accumulation area above the timberline. Measurements of insolation during the Indian Peaks snowmelt season indicate that the average diurnal trajectory of solar transmission is highly asymmetric with lower values occurring in the afternoon when cloud coverage is maximum. A statistical analysis of simulated insolation suggests that topographic factors interact with prevailing sky conditions to produce a complex pattern of topoclimates within the study area. Differences between insolation topoclimates are not stationary; they depend upon timing and degree of cloud coverage as reflected in the diurnal trends of solar transmissions. On an average summer day (clear morning-cloudy afternoon), simulated insolation to north and south facing basins is roughly equivalent, while east facing basins receive the largest daily totals. These findings are important to snow hydrologists because relative (intramountain) differences in glacier ablation, and therefore potential basin melt, appear to be adjusted to the pattern of radiation that occurs on partly cloudy (not cloudless) days. (Murphy-IVI)
W84-04573

2D. Evaporation and Transpiration

TURFGRASS EVAPOTRANSPIRATION. II. RESPONSES TO DEFICIT IRRIGATION,
Colorado State Univ., Fort Collins. Dept. of Agronomy.
C. M. Feldhake, R. E. Danielson, and J. D. Butler.
Agronomy Journal, Vol. 76, No. 1, p 85-89, January-February, 1984. 8 Fig, 6 Ref.

Descriptors: *Irrigation practices, *Water use, Conservation, Water conservation, Canopy, Lysimeters, Nitrogen, Turfgrass, Arid regions.

In the arid west, deficit irrigation has contributed significantly to efficient use of water resources. The effect of deficit irrigation on turfgrass quality was studied using small lysimeters where root systems were confined and evapotranspiration was limited to the amount of irrigation. In most cases there was a sharp change in slope of the quality vs evapotranspiration (ET) relationship for turfgrass. Kentucky bluegrass decreased about 10% in quality with an irrigation schedule providing up to a 27% ET deficit. Larger deficits resulted in greater relative decreases in quality. When ET was maintained at greater than 30% deficits, the quality rating of Kentucky bluegrass was lower if mowed at 2 cm than when mowed at 5 cm. When N fertility was low, maximum ET and maximum quality were decreased, but the response of quality to irrigation deficits greater than 27% was similar. The response of tall fescue to deficit irrigation was similar to that of Kentucky bluegrass. Buffalograss, however, responded with notable differences. Decreasing ET also had an effect on microclimate. Turfgrass canopy temperature increased 1.7 degrees C for each 10% decrease in irrigation up to 70% decrease suggesting that, during summer months, if irrigation is limited, the effect on urban climate may become a concern. (Baker-IVI)
W84-04418

BASINWIDE WATER REQUIREMENT ESTIMATION IN SOUTHERN FLORIDA,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
S. F. Shih, L. H. Allen, Jr., L. C. Hammond, J. W. Jones, and J. S. Rogers.
Transaction of the American Society of Agricultural Engineers, Vol. 26, No. 3, p 760-766, May-June, 1983. 6 Tab, 22 Ref.

Descriptors: *Florida, *Evapotranspiration, *Water requirements, *Everglades, Irrigation requirements, Effective precipitation, Water allocation.

Penman, pan evaporation, Thornthwaite, Blaney-Criddle, and water budget methods were used to estimate basinwide monthly evapotranspiration (ET) in the Everglades Agricultural Area (EAA). The Penman method gave predictions closest to monthly basinwide water budgets and the Thornthwaite method had the largest deviations. The modified Blaney-Criddle method ranked a close second, the pan evaporation method a close third, and the Blaney-Criddle method a distant fourth. From the standpoint of data availability and ease of use, the pan evaporation and modified Blaney-Criddle methods could be used to estimate basinwide monthly water allocation because those two methods predict irrigation requirement near that estimated by the Penman method and the water budget. The total effective rainfall of approximately 800 mm is common to all methods except the Thornthwaite method which predicted 918 mm. The Soil Conservation Service method for estimating monthly effective rainfall was observed to be a satisfactory approach for the organic soil watershed of the EAA. (Moore-IVI)
W84-04438

RICE YIELD, BIOMASS, AND LEAF AREA RELATED TO EVAPOTRANSPIRATION,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
S. F. Shih, G. S. Rahi, G. H. Snyder, D. S. Harrison, and A. G. Smajstrla.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 5, p 1458-1464, September-October, 1983. 5 Fig, 3 Tab, 11 Ref. South Florida Water Management District grant 4-FCD-22.

Descriptors: *Evapotranspiration, *Crop yield, *Rice, *Everglades, *Florida, Growth stage, Water management, Biomass, Leaf area index, Seasonal variation.

Rice is being considered as an alternative crop for the Everglades Agricultural Area to reduce subsidence and preserve the organic soil, because it grows well under flooded conditions. In order to cope with the water-resource problem caused by the uneven rainfall distribution in Florida, rice evapotranspiration (ET) must to be investigated to determine whether ET would vary with growth stage. Studies on the relationships among ET, grain yield, dry biomass, and leaf area index (LAI) of rice were conducted in lysimeters and in the field. Two methods of planting rice were used: transplanting and direct seeding. There were twelve planting combinations involving spring, summer, and fall crops. Three equations involving linear leaf measurements and stem lengths were developed to estimate the LAI. Peak ET rates occurred during the reproductive stage and coincided well with the maximum LAI value. Two equations involving dry biomass and grain yield in relation to ET were also developed. The relationship between dry biomass (DB) and ET was found to be: DB = 4715.2 + 303.1 ET. Grain yield (rough rice at 12% moisture, GY) was related to ET as: GY = 3995.8 + 174.9 ET. With an average rice yield in the Everglades of Florida, the total ET requirement would be about 54 cm. Planting dates may have to be adjusted to avoid the peak water demand coinciding with the dry season in the Everglades. (Moore-IVI)
W84-04473

EVAPOTRANSPIRATION FROM A HUMID-REGION DEVELOPING CITRUS GROVE WITH GRASS COVER,
Florida Univ., Gainesville.
J. S. Rogers, L. H. Allen, Jr., and D. V. Calvert.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 6, p 1778-1783 and 1792, November-December, 1983. 2 Fig, 10 Tab, 25 Ref.

Descriptors: *Evapotranspiration, *Citrus fruits, *Irrigation demand, *Florida, Grass, Hydrologic budget, Soil water, Mathematical equations, Humid areas.

The planning of irrigation water supplies and the design and operation of irrigation systems require reliable evapotranspiration (ET) data, but long-term data on water used by crops in humid regions are limited. The ET of a developing citrus grove in a humid climate in the South Florida Flatwoods Land Resource Area was determined by water balance from measured rainfall, irrigation, subsurface drainage, surface runoff, and the change in soil moisture storage. The change in soil moisture storage was estimated from soil moisture characteristic curves and measured water table elevations. Annual ET ranges from 820 to 1280 mm and averaged 1090 mm across all treatments. When soil moisture was not seriously limited the annual ET averaged 1210 mm. Linear regression of ET vs time indicated a significant increase of 13% in ET over the 8 years of the study. This increase was attributed to increasing tree size since the grass understory was maintained to provide similar cover conditions throughout the study. Daily ET rate, averaged by months, ranged from 1.5 mm in January to 5.0 mm in June. Four predictive equations for ET gave good estimates of measured values, but require crop coefficients that are slightly modified from previously published values. Since a vegetation-free understory is unlikely to be practical for high water table, humid region, citrus groves, the ET data and monthly crop coefficients should be valid over a wide range of tree sizes. (Moore-IVI)
W84-04485

EVAPORATION FROM FLOWING CHANNELS,
Geological Survey, Atlanta, GA.
J. M. Fulford, and T. W. Sturm.
Journal of Energy Engineering, Vol. 110, No. 1, p 1-9, March 1984. 8 Fig, 1 Tab, 8 Ref.

Descriptors: *Evaporation, *Channels, *Mass transfer, Mathematical studies, Heat budget, Wind,.

Prediction of evaporation is an important part of engineering evaluations of water quality and quantity. Evaporation affects thermal water quality because of the surface heat flux associated with it. In arid climates, evaporation losses in water budget calculations can be an important factor in water quantity determinations. Stability-dependent and Dalton-type mass transfer formulas determined from experimental evaporation data in ambient and heated channels have similar performance in prediction of evaporation. The formulas developed are compared with those proposed by others for lakes and flowing channels. Neither a Dalton-type nor a stability-dependent formula for the wind function was clearly superior for determining evaporation from flowing channels. For the heated channel, however, the constant in the Dalton-type formula was explained well by the formulation of the free-convection term in the stability-dependent formula. This suggests that the stability-dependent formula may be more appropriate for heated chan-

nels in which a large variation in the free-convection transport term is expected. Further studies of the evaporation from flowing channels, in which the effects of wind fetch and shielding can be more accurately determined are needed. (Baker-IVI)
W84-04491

TRANSFER OF MASS AND ENERGY IN A CASSAVE (MANIHGT ESCULENTA CRANTZ VS. CUBANA) COMMUNITY 1. MICROCLIMATE AND WATER VAPOUR EXCHANGE IN A SAVANNA CLIMATE,
Instituto Venezolano de Investigaciones Cientificas, Caracas.
J. J. San Jose, and F. Berrade.
Annals of Botany, Vol. 52, No. 4, p 507-520, October, 1983. 8 Fig, 2 Tab, 33 Ref.

Descriptors: *Cassava, *Microclimate, *Water vapor, *Savanna climate, Energy balance, Climates, Water requirements, Humidity, Canopy, Soil-water-plant relationships.

The energy balance approach was used to evaluate the transfer processes which occur between a cassava community, growing during a savanna wet season, and its environment. Crop performance under these conditions was also analyzed. During this season, the soil profile remained near saturation, hence net radiation absorbed by the cassava crop during typical low radiation days, was mainly dissipated as latent heat (78-86%); a process which depends on the growth stage and on the foliage cover of the canopy. However, the seasonal root environment, with a sufficient water supply, contrasted with the extremely variable shoot environment, because the daily flux density of short wave radiation input reached values similar to those reported for typical dry season days. On these days, cassava responded to environmental stress mainly by a reduction in transpiration. At the end of the wet season soil water content markedly decreased, an additional stress factor on the roots, which produced a notable reduction of cassava leaf area index. Therefore, the moderate changes in energy partitioning determined by morphological and physiological adaptive responses of cassava, produce a hindrance in the equilibrium between water vapor transfer and the surrounding savanna environment. (Author's abstract)
W84-04531

EFFECTS OF WIND VELOCITY ON STOMATAL CONDUCTANCE AND CONSEQUENCES OF LEAF ROLLING ON WATER UPTAKE IN TALL FESCUE,
Universite Catholique de Louvain, Louvain-la-Neuve (Belgium).
For primary bibliographic entry see Field 2I.
W84-04774

2E. Streamflow and Runoff

TECHNIQUE FOR ESTIMATING DEPTH OF FLOODS IN TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
C. R. Gamble.
USGS Open-File Report 83-4050, 1983. 21 p, 6 Fig, 2 Tab, 5 Ref.

Descriptors: *Floods, *Flood plains, *Regression analysis, Flood plain management, Hydrologic data, *Flood depth, Flood-prone area mapping, *Tennessee.

Estimates of flood depths are needed for design of roadways across flood plains and for other types of construction along streams. Equations for estimating flood depths in Tennessee were derived using data for 150 gaging stations. The equations are based on drainage basin size and can be used to estimate depths of the 10-year and 100-year floods for four hydrologic areas. A method also was developed for estimating depth of floods having recurrence intervals between 10 and 100 years. Standard errors range from 22 to 30 percent for the 10-year depth equations and from 23 to 30 percent for the 100-year depth equations. (USGS)
W84-04242

MEAN ANNUAL RUNOFF AND PEAK FLOW ESTIMATES BASED ON CHANNEL GEOMETRY OF STREAMS IN SOUTHEASTERN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
R. J. Omang, C. Parrett, and J. A. Hull.
USGS Water-Resources Investigations Report 82-4092, April, 1983. 33 p, 19 Fig, 5 Tab, 28 Ref.

Descriptors: *Annual runoff, Regression analysis, *Estimating equations, Ephemeral streams, Perennial streams, Gaging stations, Crest gage, Streamflow, Active-channel width, Bankfull width, Channel geometry, *Montana, Basin characteristics, *Peak flow.

Equations using channel-geometry measurements were developed for estimating mean runoff and peak flows of ungaged streams in southeastern Montana. Two separate sets of esitmating equations were developed for determining mean annual runoff: one for perennial streams and one for ephemeral and intermittent streams. Data from 29 gaged sites on perennial streams and 21 gaged sites on ephemeral and intermittent streams were used in these analyses. Data from 78 gaged sites were used in the peak-flow analyses. Southeastern Montana was divided into three regions and separate multiple-regression equations for each region were developed that relate channel dimensions to peak discharge having recurrence intervals of 2, 5, 10, 25, 50, and 100 years. Channel-geometery relations were developed using measurements of the active-channel width and bankfull width. Active-channel width and bankfull width were the most significant channel features for estimating mean annual runoff for al types of streams. Use of this method requires that onsite measurements be made of channel width. The standard error of estimate for predicting mean annual runoff ranged from about 38 to 79 percent. The standard error of estimate relating active-channel width or bankfull width to peak flow ranged from about 37 to 115 percent. (USGS)
W84-04270

SPRING BREAKUP AND FLUSHING OF AN ARCTIC LAGOON ESTUARY,
Alaska Univ., Fairbanks. Geophysical Inst.
For primary bibliographic entry see Field 2C.
W84-04298

ESTIMATION OF LOG-NORMAL QUANTILES: MONTE CARLO RESULTS AND FIRST-ORDER APPROXIMATIONS,
Hokkaido Univ., Sapporo (Japan). Dept. of Civil Engineering.
K. Hoshi, J. R. Stedinger, and S. J. Burges.
Journal of Hydrology, Vol. 71, No. 1-2, p 1-30, March 15, 1984. 1 Fig, 14 Tab, 51 Ref. NSF grant CME8010889.

Descriptors: *Log-normal quantiles, *Monte Carlo method, *Mathematical models, Flood frequency, Three-parameter log-normal distribution, Flood flow.

The three-parameter log-normal (LN3) distribution is often used to describe hydrologic data, particularly for synthetic streamflow generation and for flood frequency analysis. Monte Carlo estimates of the average bias and root mean square error achieved with different quantile estimation procedures for the three-parameter log-normal distribution allow a comparison of the method's performance. The maximum likelihood method, method of moments, and two quantile-lower-bound estimators in combination with two moments in real or in log space were considered. The maximum likelihood method and Stedinger's quantile-lower-bound methods provide more accurate estimators of the 1 and 10 percentiles of the distribution. No method was best for estimating the 99 and 99.8 percentiles. First-order approximations provide reasonable estimates of the estimators' sampling variance in most cases. All quantile estimators of the 99 or 99.8 percentiles of a flood-flow distribution were shown to yield design flood values which will be exceeded with probabilities substantially in excess of 1% and 0.2%, respectively. (Murphy-IVI)
W84-04299

SOME ASPECTS OF RIVER FLOW IN NORTHERN NEW SOUTH WALES, AUSTRALIA,
Hull Univ. (England). Dept. of Geography.
R. C. Ward.
Journal of Hydrology, Vol. 71, No. 1-2, p 31-51, March 15, 1984. 12 Fig, 2 Tab, 9 Ref.

Descriptors: *River flow, *New South Wales, *Australia, Streamflow, *Great Divide, Average flow, Flood flow, Flow duration, Precipitation, Runoff, Rainfall-runoff relationships.

A number of catchment and hydrological characteristics are examined for a 385,000 sq km study area in northern New South Wales. This study area spans the Great Divide and data selected from the archives of the New South Wales Water Resources Commission illustrate the marked contrasts in the character and viability of streamflow between coastal rivers draining comparatively small steeply sloping basins east of the Great Divide and the larger river systems draining the more extensive semi-arid basins of the western slopes. Particular attention is paid to comparisons of annual flows, flow-duration curves, seasonal flow regimes, flood flow and low flows. The study not only confirms the hydrological contrasts between two distinct geographical regions but also emphasizes the rigorous data requirements of hydrological studies in areas of high variability of precipitation and streamflow. (Author's abstract)
W84-04300

THE GENERATION OF STORM RUNOFF IN A FORESTED CLAYEY DRAINAGE BASIN IN LUXEMBOURG,
James Cook Univ. of North Queensland, Townsville (Australia). Dept. of Geography.
M. Bonell, M. R. Hendriks, A. C. Imeson, and L. Hazelhoff.
Journal of Hydrology, Vol. 71, No. 1-2, p 53-77, March 15, 1984. 7 Fig, 3 Tab, 78 Ref.

Descriptors: *Storm runoff, *Catchment areas, *Luxembourg, Clayey soils, Rainfall-runoff relationships, Hydrographs, Soil horizons.

The clayey soils on the gently sloping forested Keuper formations of Luxembourg are characterized by a microtopography of shallow depressions and ridges. During rainfall in the winter months, when a seasonal water table develops above the almost impermeable B horizon, the depressions and the slopes draining to them generate storm runoff. Storm-runoff generation in one of these depressions, in the Schrondweilerbaach drainage basin near Ettelbruck, was investigated between November 1979 and January 1983. Runoff leaving the drainage basin was examined with respect to water-table elevations and soil conditions. This included investigating the relationship between the recession characteristics of the well and plot-runoff hydrographs and the soil profile. Of particular importance for runoff generation is the high degree of biological activity in the nutrient-rich soils and the resulting high macroporosity of the A11 horizon. It appears that storm runoff is produced when the water table rises above the base of the A12 horizon in the A11 horizon. On all slopes, on about eight occasions each year, rainfall amounts and intensities are sufficient to raise the water table to a position at or within a few centimeters of the surface, and saturation overland flow occurs. This overland flow travels at lower velocities than water moving in the narrow tunnels and animal burrows in the A11 horizons, from which it is difficult to distinguish. Overland flow was recorded when the maximum 30-min. rainfall during a storm exceeded 1.5 mm. Soil properties controlling the rainfall-runoff relationship are dynamic and related to the forest and soil ecology. For this reason it is not possible to extrapolate the conditions described in this paper to ecologically different areas. (Author's abstract)
W84-04301

AN EVALUATION OF THE PERFORMANCE OF A FINITE DIFFERENCE APPROXIMA-

TION OF THE KINEMATIC WAVE SPEED EQUATION,
Institute of Hydrology, Wallingford (England).
S. E. Wiltshire, and P. Novak.
Journal of the Institution of Water Engineers and Scientists, Vol. 38, No. 1, p 61-69, February, 1984. 6 Fig, 2 Tab, 7 Ref.

Descriptors: *Kinematic wave speed equation, *Performance evaluation, Comparison studies, Kinematic wave model, Mathematical model, Hydrographs, Wave velocity, Waves, Flood waves.

The concept of a kinematic wave has enjoyed an increasing popularity since its development, as it appears to offer in many situations - particularly in the study of natural flood waves - a viable simplification of the dynamic wave. A comparison of 130 recorded wave speeds in three reaches of the river Wear with those calculated from the kinematic wave model shows a fair measure of agreement, given the disparity between model assumptions and real conditions. The agreement is improved by treating the three reaches of the river separately. Values of the wave speed:water speed ratio calculated from observed hydrographs also compare favorably, and show reasonable agreement with values predicted by the kinematic wave theory in the case of higher floods and/or high flood rises. (Murphy-IVI)
W84-04320

REAL-TIME APPLICATION OF THE ISOLATED EVENT RAINFALL-RUN-OFF MODEL,
Greater London Council (England). Dept. of Public Health Engineering.
W. S. Eyre, and M. A. Crees.
Journal of the Institution of Water Engineers and Scientists, Vol. 38, No. 1, p 70-78, February, 1984. 5 Fig, 14 Ref.

Descriptors: *Real-time application, *Isolated event rainfall-runoff model, Rainfall-runoff model, Flood forecasting, Flood hydrographs, Isolated event model, Telemetry.

The Isolated Event Model (IEM4) is a four-parameter non-linear conceptual rainfall-runoff model which was developed for flood estimation but which more recently has been used for flood forecasting. In February 1982 the London Weather Radar Project (LWRP) was formed with the aim of establishing an unmanned weather radar station to provide precipitation data, in near real-time, for an area extending up to 210 km in radius from the radar station. The LWRP is a consortium made up of the Meteorological Office, the Greater London Council (GLC), the Thames Water Authority and the Southern Water Authority. The GLC joined the consortium with the aim of offering an improved flood warning service to those authorities responsible for areas adjacent to London's non-tidal rivers. The acquisition of near real-time precipitation data is one-half of the program to improve this flood warning service, the other half being the upgrading of the existing telemetry network by the addition of micro-processors at 20 autographic rainfall stations and at 22 river-level gauging stations. These micro-processors will enable data capture and alarm monitoring by a mini-computer. It is anticipated that both the weather radar and the enhanced hydrometric system will be operational by the summer of 1984. To make full use of these data and the processing potential of the mini-computer it was decided to investigate several rainfall-run-off models with a view to running them in real-time during a flood event. The results of the application of one such model, the Isolated Event Model, to a small urbanized catchment in London is presented. (Murphy-IVI)
W84-04321

NUMERICAL INTEGRATION OF STOCHASTIC DIFFERENTIAL EQUATIONS IN CATCHMENT MODELING,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
T. E. Unny.
Water Resources Research, Vol. 20, No. 3, p 360-368, March, 1984. 4 Fig, 9 Tab, 23 Ref.

Descriptors: *Catchment areas, *Model studies, *Stochastic process, *Differential equations, Mathematical equations, Streamflow, Rainfall-runoff relationships.

A catchment-based stochastic model has been developed for the generation of streamflows fed by random inputs of rainfall. The model is a stochastic differential equation (SDE) of the Stratonovich type. Integration procedures for this SDE, as well as for its equivalent Ito SDE, are discussed. An important result is that the integration procedure should be carefully chosen to agree with the definition of the stochastic differential equation as an Ito equation or as a Stratonovich equation. Euler integration is applicable only to Ito SDE, and similarly, Runge-Kutta procedures of integration are applicable only to Stratonovich SDE. Numerical integration of the model provides sample functions that can be considered as representative of streamflow time series. In addition to stochastic models for inputs (for rainfall, for catchment abstraction, and for reservoir surface evaporation,) the catchment model requires specification of the parameters representing the characteristics of the conceptual reservoir. (Baker-IVI)
W84-04360

STOCHASTIC STREAMFLOW MODELS FOR HYDROELECTRIC SYSTEMS,
Centro de Pesquisas de Energia Electrica, Rio de Janeiro (Brazil).
M. V. F. Pereira, G. C. Oliveira, C. C. G. Costa, and J. Kelman.
Water Resources Research, Vol. 20, No. 3, p 379-390, March, 1984. 10 Fig, 4 Tab, 10 Ref.

Descriptors: *Streamflow, *Model studies, *Stochastic process, *Hydroelectric plants, *Brazil, Economic aspects, Planning, Model selection.

Streamflow records play a critical role in the planning and operation studies of a hydroelectric system. A monthly streamflow model is developed for the Brazilian hydroelectric system. The model is based on the disaggregation of lag 1 autoregressive annual flows into monthly values. Model features include addition of new sites, nonparametric generation of monthly flows, and correction of negative values. The work is organized in three main parts: theoretical and practical aspects of model development; criteria for assessing the adequacy of a model; and economic effect of model selection. A methodology for assessing model adequacy is applied in a case study comparing the proposed model and a multivariate monthly autoressive model. The economic effect of model selection is illustrated in a realistic generation planning case study: it is shown that investment differences resulting from the application of different models may reach US $1 billion. Efficient model selection procedures are essential for the successful application of stochastic models in planning studies. The adopted validation scheme was able to show sharp differences between models that were apparently very similar. (Moore-IVI)
W84-04362

LINK LENGTH DISTRIBUTIONS IN DRAINAGE NETWORKS WITH LAKES,
State Univ. of New York at Buffalo. Dept. of Geography.
D. M. Mark, and R. Averack.
Water Resources Research, Vol. 20, No. 4, p 457-462, April, 1984. 2 Fig, 6 Tab, 20 Ref. Natural Sciences and Engineering Research Council of Canada grant A7999.

Descriptors: *Stream links, *Drainage patterns, *Lakes, Classification, Stream classification, Topography, Model studies, Drainage, Canada.

A classification system for stream links in drainage networks containing lakes is introduced. For two study areas the observed frequencies of these link types differ significantly from expected values predicted by topological randomness. Mean link lengths vary significantly across link types, with links beginning at point sources tending to be longer than other types. The mixed-gamma distribution provides a good fit to link length distributions. The mixing parameters for link types beginning at point sources are similar to values reported for exterior links are lake-free networks. Shape parameters for most other link types are near or below 2. Because the glacially deranged drainage systems studied are not adjusted to fluvial processes, frequency distributions of link lengths more closely approach the exponential distribution which should characterize randomly merging links. One of the important applications of link length information with networks without lakes has been to combine this information with network topology models to predict main stream lengths, drainage densities, and other aggregate length properties of drainage basins. There is a fairly strong correlation between lake size and number of inlet streams. (Murphy-IVI)
W84-04569

PREDICTION OF ALTERNATE BAR WAVELENGTH AND HEIGHT,
Saitama Univ. (Japan). Dept. of Foundation Engineering.
S. Ikeda.
Journal of Hydraulic Engineering, Vol. 110, No. 4, p 371-386, April, 1984. 13 Fig, 4 Tab, 30 Ref.

Descriptors: *Alternate bar wavelength, *Alternate bar height, *Prediction, Mathematical equations, Streamflow, Channel flow, Natural flow, Flow models, Bar wavelength, Bar height, Japan.

Several formulas are theoretically and empirically proposed for the alternate bar wavelength. It is found that one formula derived in terms of bar stability analysis is invalid for F > or = 0.8; an alternative empirical formula which is valid for F > or = 0.8 is proposed. A new formula on the bar height is also obtained empirically on the basis of laboratory data. These formulas are applied to an actual river, and are shown to be reasonable in predicting the bar wavelength and bar height. The possible errors of prediction are estimated to be within about +80% and -40% for both formulas. (Murphy-IVI)
W84-04589

PLUNGING FLOW INTO A RESERVOIR: THEORY,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
J. Akiyama, and H. G. Stefan.
Journal of Hydraulic Engineering, Vol. 110, No. 4, p 484-499, April, 1984. 11 Fig, 26 Ref.

Descriptors: *Plunging flow, *Reservoirs, Flow, Underflow, Conceptual flow model, Model studies, Flow characteristics, Froude number.

When the inflow into a reservoir or lake has a density greater than that of the reservoir water, a plunging flow will occur. The analysis of the plunging phenomenon is of importance in reservoir water quality management and modeling because inflows transport suspended and dissolved solids into various portions of stratified reservoirs. The flow considered herein is a two-dimensional negatively buoyant flow from a shallow channel over a sloping bottom (mild or steep) into a well-mixed reservoir. For the analysis, a set of integral equations, in particular the equations of conservation of mass and volume, and the momentum equation, are employed. This study is concerned with the analysis of the plunging phenomenon and is directed towards prediction of the depth at the plunge point in terms of the essential independent parameters governing the problem. These predictions include the inflow densimetric Froude number Fo, the initial mixing rate, gamma, the bed slope, S, and the total friction coefficient, f sub t. The equations for plunging depth presented in this study agree well with available laboratory and field data. (Murphy-IVI)
W84-04592

POTENTIAL FLOW THROUGH CHANNEL CONSTRICTION,

Geological Survey, NSTL Station, MS. Gulf Coast Hydroscience Center.
J. K. Lee.
Journal of Hydraulic Engineering, Vol. 110, No. 4, p 515-520, April, 1984. 2 Fig, 6 Ref.

Descriptors: *Potential flow, *Channel constriction, Flow characteristics, Flood plain, Energy loss, Backwater, Backwater curve, Mathematical models, Schwarz-Christoffel transformation.

Standard methods for computing backwater at width constrictions of flood plains severely underestimate backwater when the flood plain is wide and heavily vegetated. The energy-loss term for the approach reach upstream from a constriction depends on the average streamline length in the reach. In standard one-dimensional step-backwater procedures, this average streamline length is approximated by the length of the approach reach. Calculation of energy loss in the approach reach can be improved if a more accurate estimate of the average streamline length is used. Potential-flow streamlines are reasonable approximation to physical streamlines for convergent flow outside the boundary layer if flood-plain depth and roughness are fairly uniform. Potential flow through an eccentric, normal constriction of zero thickness in an infinitely long, straight channel of constant width and unit depth is studied by use of a Schwarz-Christoffel transformation. The transformation is integrated by a direct approach. Parametric equations for streamlines are obtained and used to compute an average streamline length for a potential-flow field. (Author's abstract)
W84-04593

FLOW AND BED TOPOGRAPHY IN ALLUVIAL CHANNEL BEND,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
A. J. Odgaard.
Journal of Hydraulic Engineering, Vol. 110, No. 4, p 521-536, April, 1984. 5 Fig, 22 Ref. Army Corps of Engineers contract DACW39-80-C-0129.

Descriptors: *Flow, *Bed topography, *Alluvial channel bends, Channel erosion, Alluvial channels, Model studies, Missouri River, Sacramento River.

Two of the most striking and intriguing features of natural alluvial streams are their natural tendency to meander, and the migration of the meanders. River meandering, in particular the bank erosion attendant to the growth and migration of the meander loops, has become a major problem in many countries. Two recently developed analytical approaches to a description of the fully developed flow and bed topography in alluvial channel bends are extended to include a description of the development of the flow and bed topography in the initial portion of bends. The approaches have been verified by tests in a laboratory-channel bend. The results of the study show that the bed topography develops and decays over a much shorter distance than does the velocity profile. The eccentricity of the centers of volume flux appears to oscillate along the channel with a period that is comparable to that predicted by a meander theory. The analyses are limited to the central portion of the channel cross section, where bank effects are negligible. (Murphy-IVI)
W84-04594

THE USE OF RADAR FOR FLOOD WARNING AND FORECASTING IN THE CRITICAL BASINS OF THE VEZERE AND CORREZE (LE RADAR ET LA PLUIE. APPLICATION A L'ANNOUNCE ET A LA PREVISION DES CRUES DANS LES BASSINS CRITIQUES DE LA VEZERE ET DE LA CORREZE),
Service Hydrologique Centralisateur du Bassin de la Garonne, Toulouse (France).
For primary bibliographic entry see Field 2B.
W84-04647

THE USE OF RADAR AS AN AID TO QUANTITATIVE ESTIMATION OF PRECIPITATION. FORECASTING SUDDEN FLOODS IN MARTINIQUE (LE RADAR COMME AIDE A L'ESTIMATION QUANTITATIVE DES PRECIPITATIONS. PREVISION DES CRUES ECLAIRS EN MARTINIQUE),
Service Meteorologique Metropolitain, Le Bourget (France).
For primary bibliographic entry see Field 2B.
W84-04648

DILUTION AND ACIDIFICATION EFFECTS DURING THE SPRING FLOOD OF FOUR SWEDISH MOUNTAIN BROOKS,
National Swedish Environment Protection Board, Solna.
B. Bjarnborg.
Hydrobiologia, Vol. 101, No. 1/2, p 19-26, April, 1983. 5 Fig, 1 Tab, 9 Ref.

Descriptors: *Acidic water, *Mountain streams, *Snowmelt, Hydrogen ion concentration, Cumulative runoff, Runoff, Aluminum, Iron, Nitrogen, Phosphorus, Soil properties, Sensitivity analysis.

The seasonal variation in water chemistry was followed during 1980 and 1981 in four mountain brooks in the southern part of Swedish Lapland. In the area investigated the soil is calcareous and the brook water is very well buffered during the major part of the year, with alkalinity varying between 0.4 and 1.0 milliequivalents per liter and with pH values about 7.5. These years the snow had a pH of approximately 5.2, which was considerably higher than has been reported from adjacent areas in the lower, coniferous region. During snowmelt the water discharge increased drastically, and although the net transport of bicarbonate increased, alkalinity showed low values due to dilution with meltwater, pH decreased, but no further than to 6.3-6.5, far from values reported in 1979 (pH less than 5), apparently due to the comparatively clean snow. A slight deficit in alkalinity, as compared to the nonmarine calcium and magnesium content, points to an acidification impact on the area. During the maximum runoff some chemical variables, like aluminium, iron, nitrogen and phosphorus, behaved reversely to what might be expected during dilution and reached maxima in concentrations. It is concluded that the extreme runoff characteristics of high mountain areas make brook water more sensitive to acid precipitation than might be expected when regarding only the calcareous properties of soil and bedrock. (Author's abstract)
W84-04697

2F. Groundwater

ESTIMATION OF RECHARGE IN A SMALL SOUTHERN ARIZONA BASIN BY MEANS OF HYDROLOGICAL, HYDROCHEMICAL, AND ENVIRONMENTAL ISOTOPE DATA,
Arizona Water Resources Research Center, Tucson.
S. P. Neuman, and E. Adar.
Available from National Technical Information Service, Springfield, VA 22161 as PB84-159672, Price codes: A07 in paper copy, A01 in microfiche. Completion Report, December, 1983. 134 p, 36 Fig, 83 Ref, 3 Append. Project No. OWRT A-099-ARIZ (1), Contract/Grant No. 14-34-0001-1103.

Descriptors: *Groundwater recharge, Flow model, Environmental tracers, *Hydrochemistry, Optimization, Geohydrology, Arid basin, Oxygen isotopes, Hydrogen isotopes, Carbon isotopes, *Arizona, Aravaipa basin.

A mathematical model is proposed to estimate the ratios between various components of recharge into an alluvial aquifer system. The model is similar in principle to one developed earlier by Woolhiser et al. (1982) the river channels. It is based on long-term average mass balance expressions applied to water and various dissolved chemical constituents, coupled with a quadratic programming optimization scheme. The suitability of this model to the semiarid Aravaipa basin in southern Arizona is explored. Potential components of recharge into the basin are identified qualitatively on the basis of hydro-geological, hydrological, hydrochemical, and hydroisotope data. A method to obtain quantitative estimates of these components is outlined. Actual application of the quantitative model to the Aravaipa basin will be the subject of a future report.
W84-04231

CONFIGURATION OF THE BASE AND THICKNESS OF THE UNCONFINED AQUIFER IN SOUTHEASTERN SUSSEX COUNTY, DELAWARE,
Geological Survey, Towson, MD. Water Resources Div.
J. M. Denver.
USGS Open File Report No. 20, May, 1983. 12 p, 8 Fig, 14 Ref.

Descriptors: *Unconfined aquifer, Atlantic Coast Plain, *Delaware, *Aquifer thickness, *Altitude of base, Sussex County.

The altitude of the base of the unconfined aquifer in the study area ranges from 29 feet to more than 175 feet below the NGVD of 1929. The deepest section extends from Indian River Bay to Selbyville and coincides with the subcrop area of a confined Miocene aquifer. Saturated thickness is greatest in the same area. Geologic, geophysical, and drillers' logs were used to prepare five geologic sections and a configuration map of the base of the unconfined aquifer. A map of the thickness was prepared by subtracting the altitude of the base of the aquifer from the altitude of the water table. (USGS)
W84-04243

DIGITAL MODEL OF THE BATES CREEK ALLUVIAL AQUIFER NEAR CASPER, WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
K. C. Glover.
Available from the Ofss, USGS, Lakewood, CO 80225, Price: $6.50 paper copy, $3.50 microfiche. USGS Water Resources Investigations Report 82-4068, 1983. 45 p, 9 Fig, 13 Tab, 12 Ref.

Descriptors: Water supply, *Alluvial aquifers, Ground-surface water relationships, *Wyoming, Computer model, Simulation analysis, Bates Creek, Streamflow depletion.

A digital model was used to simulate ground-water flow within the Bates Creek alluvial aquifer, southwest of Casper, Wyoming. Hydrologic data collected during 1977 and 1978 were used to develop the flow model under steady-state and transient conditions. Three scenarios for operating the stream-aquifer system were evaluated with the digital model. The scenarios represent no ground-water pumping, pumping by all existing wells, and pumping by all existing and proposed wells. The model simulations used average values of stream discharge, ground-water pumpage and water use as input parameters. A decrease in the quantitity of ground-water discharge to Bates Creek is predicted to occur through 1988 as a result of pumping. The magnitude and timing of the predicted decrease in ground-water discharge may differ from actual ground-water discharge if hydrologic conditions through 1988 vary significantly from the averaged input values used in the simulations. (USGS)
W84-04260

HYDROLOGY AND SUBSIDENCE POTENTIAL OF PROPOSED COAL-LEASE TRACTS IN DELTA COUNTY, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 4C.
W84-04262

GROUND-WATER-USE TRENDS IN THE TWIN CITIES METROPOLITAN AREA, MINNESOTA, 1880-1980,
Geological Survey, St. Paul, MN. Water Resources Div.

For primary bibliographic entry see Field 6D.
W84-04266

AVAILABILITY AND CHEMICAL QUALITY OF WATER FROM SURFICIAL AQUIFERS IN SOUTHWEST MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
D. G. Adolphson.
USGS Water-Resources Investigations Report 83-4030, 1983. 37 p, 13 Fig, 10 Tab, 31 Ref.

Descriptors: *Groundwater resources, *Aquifer characterics, *Lithologic logs, *Water quality, Cottonwood County, Jackson County, Lincoln County, Murray County, Nobles County, Pipestone County, Redwood County, Rock County, *Minnesota.

The principal surficial aquifers in southwest Minnesota consist of outwash and alluvium material deposited in river valleys. The largest and most productive of these aquifers occupy the valleys of the Cottonwood, Des Moines, Redwood, and Rock Rivers and of tributaries to the Big Sioux River. Minor aquifers, adequate only for farm or domestic use, occur in the valleys of tributaries to the major streams. The surficial aquifers range in width from half a mile to 2 miles, in thickness from 0 to 110 feet, and in saturated thickness from 0 to 80 feet. Grain size varies both laterally and vertically. A veneer of fine-grained sediment, as much as 15 feet thick, has been deposited over the outwash by postglacial streams. Availability of water in the surficial aquifers varies greatly within short distances. Probable maximum well yield is as much as 1,000 gallons per minute; however, yields generally range from 10 to 100 gallons per minute. The concentration of dissolved solids in water from the surficial aquifers ranges from about 300 to 960 milligrams per liter. Analyses of 25 samples show that locally the water contains concentrations of iron, sulfate, and nitrate (as nitrogen) that are above the limits recommended by the Minnesota Department of Health for drinking water. Based on these standards, the water is of acceptable chemical quality for most uses, although it is hard. (USGS)
W84-04269

A DIGITAL-COMPUTER MODEL OF THE BIG SIOUX AQUIFER IN MINNEHAHA COUNTY, SOUTH DAKOTA,
Geological Survey, Helena, MT. Water Resources Div.
N. C. Koch.
USGS Water-Resources Investigations Report 82-4064, October, 1982. 49 p, 14 Fig, 8 Tab, 11 Ref.

Descriptors: *Computer models, *Aquifers, *Surface groundwater relationships, Water budget, Minnehaha County, *South Dakota.

A finite-difference digital model was used to simulate steady-state conditions of the Big Sioux aquifer in Minnehaha County. Average water levels and average base flow discharge (4.9 cu ft/s) of the Big Sioux River were based on data from 1970 through 1979. The computer model was calibrated for transient conditions by simulating monthly historic conditions for 1976. During 1976, pumpage was offset mostly by surface-water recharge to the aquifer from January through June and groundwater discharge from storage from July through December. Measured drawdowns during 1976 generally were less than 2 feet except in the Sioux Falls city well field where drawdowns were as much as 15 feet. The model was used to study the effects of increased withdrawals under three hypothetical hydrologic situations. One hypothetical situation consisted of using 1976 pumping rates, recharge, and evapotranspiration but the Big Sioux River dry. The pumping rate after 16 months was decreased by 40 percent from the actual pumping rate for that month in order to complete the monthly simulation without the storage being depleted at a nodal area. The second hypothetical situation consisted of a pumpage rate of 44.4 cubic feet per second from 60 wells spaced throughout the aquifer under historic 1976 hydrologic conditions. The results were that the aquifer could supply the additional withdrawal. The third hypothetical situation used the same hydrologic conditions as the second except that recharge was zero and the Big Sioux River was dry downstream from row 54. After 18 monthly simulations, the pumping rate was decreased by 44 percent to prevent pumping wells from depleting the aquifer, and, at that rate, 63 percent of the water being pumped was being replaced by water from the river. (USGS)
W84-04271

GROUNDWATER CONTAMINANT TRANSPORT MODELING,
Princeton Univ., NJ. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W84-04289

INTERPRETATION OF EARTH TIDE RESPONSE OF THREE DEEP, CONFINED AQUIFERS,
California Univ., Berkeley. Lawrence Berkeley Lab.
T. N. Narasimhan, B. Y. Kanehiro, and P. A. Witherspoon.
Journal of Geophysical Research, Vol. 89, No. B3, p 1913-1924, March 10, 1984. 7 Fig, 5 Tab, 22 Ref. Department of Energy contract W-7405-ENG-48.

Descriptors: *Tidal effects, *Confined Aquifers, *Earth tides, Tidal hydraulics, Porous media, Pore pressure, Hydrodynamics.

The response of a confined, areally infinite aquifer to external loads imposed by earth tides is examined. Because the gravitational influence of celestial objects occurs over large areas of the earth, the confined aquifer is assumed to respond in an undrained fashion. Since undrained response is controlled by water compressibility, earth tide response can be directly used only to evaluate porous medium compressibility if porosity is known. Moreover, since specific storage Ss quantifies a drained behavior of the porous medium, one cannot directly estimate Ss from earth tide response. Except for the fact that barometric changes act both on the water surface in the well and on the aquifer as a whole while stress changes associated with earth tides act only in the aquifer, the two phenomena influence the confined aquifer in much the same way. In other words, barometric response contains only as much information on the elastic properties of the aquifer as the earth tide response does. Factors such as well bore storage, aquifer transmissivity, and storage coefficient contribute to time lag and damping of the aquifer response as observed in the well. Analysis shows that the observation of fluid pressure changes alone, without concurrent measurement of external stress changes, is insufficient to interpret uniquely earth tide response. In the present work, change in external stress is estimated from dilatation by assuming a reasonable value for bulk modulus. Earth tide response of geothermal aquifers from Marysville, Montana; East Mesa, California; and Raft River Valley, Idaho, were analyzed, and the ratio of Ss to porosity was estimated. Comparison of these estimates with independent pumping tests shows reasonable agreement. (Author's abstract)
W84-04295

NONLINEAR DIFFUSION WITH LINEARLY VARYING DIFFUSIVITY,
Thessaloniki Univ., Salonika (Greece). School of Technology.
P. K. Tolikas, and E. Sidiropoulos.
Journal of Hydrology, Vol. 71, No. 1-2, p 181-190, March 15, 1984. 2 Fig, 1 Tab, 12 Ref.

Descriptors: *Groundwater movement, *Mathematical equations, *Diffusion, Groundwater pollution, Water absorption, Diffusivity.

An approximate analytical solution to the nonlinear diffusion equation is presented, which has no upper limitation as to the ratio of boundary over initial concentration. The diffusivity is assumed to be linearly dependent on concentration. The one dimensional problem is reduced to an ordinary differential equation through the Boltzmann transformation and a technique which is exploiting basic characteristics of the exact solution is developed. The technique presented can be applied to problems of groundwater contamination, to problems of water absorption into unsaturated soils, as well as to various other engineering problems leading to the diffusion equation. The analysis provides a very simple method for an approximate solution of the the problems. (Baker-IVI)
W84-04307

AN ADVECTION-DIFFUSION CONCEPT FOR SOLUTE TRANSPORT IN HETEROGENEOUS UNCONSOLIDATED GEOLOGICAL DEPOSITS,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
R. W. Gillham, E. A. Sudicky, J. A. Cherry, and E. O. Frind.
Water Resources Research, Vol. 20, No. 3, p 369-378, March, 1984. 10 Fig, 33 Ref, 1 Append.

Descriptors: *Advection, *Diffusion, *Solute transport, Unconsolidated aquifers, Permeability coefficent, Groundwater movement, Groundwater pollution, Time-dependence.

In layered permeable deposits with flow predominately parallel to the bedding, advection causes rapid solute transport in the more permeable layers. As the solute advances more rapidly in these layers, solute mass is continually transferred to the less permeable layers as a result of molecular diffusion due to the concentrations gradient between the layers. The interlayer solute transfer causes the concentration to decline along the permeable layers at the expense of increasing the concentration in the less permeable layers, which produces strongly dispersed concentration profiles in the direction of flow. The key parameters affecting the dispersive capability of the layered system are the diffusion coefficients for the less permeable layers, the thicknesses of the layers, and the hydraulic conductivity contrasts between the layers. Because interlayer solute transfer by transverse molecular diffusion is a time-dependent process, the advection-diffusion concept predicts a rate of longitudinal spreading during the development of the dispersion process that is inconsistent with the classical Fickian dispersion model. A second consequence of the solute-storage effect offered by transverse diffusion into low-permeability layers is a rate of migration of the frontal portion of a contaminant in the permeable layers that is less than the groundwater velocity. Although various lines of evidence are presented in support of the advection-diffusion concept, more work is required to determine the range of geological materials for which it is applicable and to develope mathematical expressions that will make it useful as a predictive tool for application to field cases of contaminant migration. (Author's abstract)
W84-04361

A LAGRANGIAN POROUS MEDIA MASS TRANSPORT MODEL,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W84-04363

THE RELATIVE IMPORTANCE OF COMPRESSIBILITY AND PARTIAL SATURATION IN UNCONFINED GROUNDWATER FLOW,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
W. Brutsaert, and A. I. El-Kadi.
Water Resources Research, Vol. 20, No. 3, p 400-408, March, 1984. 6 Fig, 43 Ref.

Descriptors: *Water table aquifers, *Compressibliity, *Saturation, *Groundwater movement, Aquifers, Pressure, Unsaturated flow, Water table, Geohydrology.

Water flowing in an unconfined aquifer is in contact with air through the pore space network extending to the ground surface. The transition between the region fully saturated with water and the overlying region, fully saturated with air is not sudden but gradual. The upper zone of an uncon-

fined groundwater body is usually a zone of simultaneous flow of two immiscible fluids, water and air. The flow of water in an unconfined aquifer is viewed within the framework of the Biot theory as extended for two-fluid flow and for conditions of a vertical displacement with constant load. Order of magnitude inspection and an objective criterion, obtained from similitude considerations, are dealt with to estimate the relative importance of the compressibility of aquifer matrix and water and that of partial saturation. In shallow aquifers with a large capillary fringe, the neglect of the flow in the unsaturated zone can lead to large discrepancies in the prediction of both the outflow hydrograph and the water table geometry. The ratio -psi sub t /D can be used as a criterion to characterize the relative importance of the flow in the partly saturated zone. A small value of this ratio is an indication that the effect of the flow in the partly saturated zone is negligible. When the flow in the partly saturated zone of the aquifer is not negligible, the effect of the partial saturation on the flow is likely to overwhelm any effects due to compressibility of the aquifer materials and the fluid. When the effect of partial saturation is negligible, the compressibility of the aquifer is of importance under conditions of large sudden pressure changes in the water. (Moore-IVI)
W84-04364

FINITE ELEMENT MODELING FOR DEPTH AND SPACING OF DRAINS IN LAYERED SOILS,
Michigan State Univ., East Lansing. Dept. of Agricultural Engineering.
G. E. Merva, L. Segerlind, H. Murase, and N. R. Fausey.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 2, p 452-456, April, 1983. 3 Fig, 3 Tab, 12 Ref.

Descriptors: *Subsurface drainage, *Model studies, *Water table, Finite element method, Water supply development, Soil properties, Clay, Silt, Permeability, Drainage.

Drain spacing in conjunction with soil properties governs the location in time of the groundwater table. A model is developed using available theory and the finite element method to predict the position of the water table under subsurface drainage. The model is tested and the behavior of the ground water table is characterized under several different soil regimes. The model uses the soil characteristic curve for the surface layer and hydraulic conductivities of as many as three soil layers and a trench backfill to predict locations of the soil water table. Model operation is based on steady state flow for some short time interval. The water removed from the soil for this period alters the volumetric water content of the drained soil and, through the soil characteristic curve, the soil water potential at the nodes of the finite element matrix. This action results in a new set of boundary conditions which are then used to determine a new steady state potential distribution. The model as described can be adjusted to operate at any time interval. Results of model operation appear very reasonable compared to available information. The model predicts with acceptable accuracy the position fo the free water surface for a drainage system in Toledo silty clay. Studies of multi-layered soils can be quickly accomplished with the model provided values for the soil characteristic curve of the upper layer and hydraulic conductivities and thicknesses for all layers are known. (Baker-IV)
W84-04428

THE PIT BAILING METHOD FOR HYDRAULIC CONDUCTIVITY MEASUREMENT OF ISOTROPIC OR ANISOTROPIC SOIL,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 2G.
W84-04470

STRIP BASIN RECHARGE TO INCLINED WATER TABLE,
Naval Weapons Station, Seal Beach, CA.
H. J. Hansom, and R. R. Brock.
Journal of Hydraulic Engineering, Vol. 110, No. 4, p 436-449, April, 1984. 9 Fig, 3 Tab, 16 Ref.

Descriptors: *Recharge basins, *Inclined water table, Water table, Water table fluctuations, Hydrodynamics, Mathematical models, Recharge mounds, Recharge, Groundwater movement.

An inclined water table implies that the native ground water is in motion, which is the case in practically all field situations. The emphasis of this study is on predicting the motion of the water table resulting from the recharge. The nonlinear potential (NLP) theory is used to predict the motion of the water table resulting from the recharge operation. The theoretical derivation of the NLP theory uses the saturated flow equations for a homogeneous isotropic medium. Solutions to the NLP theory for recharge to an inclined water table are obtained by using a finite difference method. The derivation of the NLP theory for strip basin recharge to an inclined water table has no limiting assumptions, so the theory can be used to predict the motion of the water-table rise for all aquifer depths. The effect of theta on the water-table rise is to create asymmetrical mounds with the maximum rise of the mound moving downstream. The effect is more pronounced as t' increases. A few examples of flow patterns showing the motion of the recharged and native water are given. The mathematical model can be utilized to predict the response and movement of recharged water in the design and operation of recharge facilities. (Murphy-IVI)
W84-04591

A COMPUTERIZED GROUND WATER MONITORING SYSTEM,
Insitu Consulting, Laramie, WY.
S.-C. Way, C. R. McKee, and H. K. Wainwright.
Journal Water Monitoring Review, Vol. 4, No. 1, p 21-25, Winter, 1984. 7 Fig, 2 Tab, 6 Ref.

Descriptors: *Monitoring, *Water quality control, *Groundwater, Computers, Water analysis, Aquifers, Transmissivity, Data acquisition.

A computer automated, hydrologic analysis system was designed to allow the collection of high quality, long-term pumping test data. The instrument solves two of the major problems encountered in the field during aquifer tests: insufficient data, particularly during the early part of a test when drawdown is rapid; and high labor costs associated with long-term monitoring. To illustrate the system's application, results are presented from the test of a highly transmissive aquifer. The aquifer's drawdown response was rapid; thus the time drawdown curve was essentially flat after the first two minutes of the test, and correspondingly rapid data acquisition was essential for a unique solution of the aquifer's three dimensional hydraulic conductivities. The SE200 Hydrologic Analysis System advances the art of hydrologic data collection and analysis and achieves its most dramatic success in comparison with other instruments when data requirements are extreme. At one extreme, the system provides consistent, reliable data collection over long periods of unattended monitoring. At the other extreme, as in the field example discussed, the system provides the extremely rapid data collection needed to obtain a unique solution for a highly transmissive or leaky aquifer. (Baker-IVI)
W84-04639

AN OVERVIEW OF COMPUTER TECHNOLOGY USED IN GROUND WATER FIELD STUDIES: PART I: BASICS,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 7B.
W84-04641

NEW TAPE FOR GROUND WATER MEASUREMENTS,
Oil Recovery Systems, Needham Heights, MA.
For primary bibliographic entry see Field 7B.
W84-04642

SOME OBSERVATIONS ON FIELD EXPERIENCES WITH MONITOR WELLS,
Ground Water Sampling, Inc., Englewood, CA.
For primary bibliographic entry see Field 7B.
W84-04643

COMPARISON OF ELECTRICAL RESISTIVITY METHODS FOR INVESTIGATION OF GROUND WATER CONDITIONS AT A LANDFILL SITE,
Lawrence Livermore National Lab., CA.
For primary bibliographic entry see Field 7B.
W84-04644

2G. Water In Soils

ERROR ANALYSIS IN ESTIMATING SOIL WATER CONTENT FROM NEUTRON PROBE MEASUREMENTS: 1. LOCAL STANDPOINT,
Centre National de la Recherche Scientifique, Grenoble (France). Inst. de Mecanique de Grenoble.
R. Haverkamp, M. Vauclin, and G. Vachaud.
Soil Science, Vol. 137, No. 2, p 78-90, February, 1984. 7 Fig, 4 Tab, 13 Ref.

Descriptors: *Error analysis, *Soil water, *Neutron probes, Analysis of variance, Mathematical analysis, Soil water potential.

A variance analysis is presented for quantifying the different sources of errors induced on volumetric water content measurements and calculation of soil water storage with the use of a neutron moisture meter in one single access tube. For comparative purposes, the analysis is applied to field data obtained with two different probes. In each case the calibration curve is established by measuring simultaneously and independently neutron count rates and corresponding water contents. Two different approaches are considered, i.e. the unbiased treatment and the biased treatment. The unbiased treatment differs from the biased by its correction for measurement errors using the least-square technique. For the site under consideration, the calibration component is the major contribution to the total variance associated with an individual water content estimation. The use of the unbiased statistical treatment notably decreases the total variance. In cases where the calibration curve is established very accurately, the instrument component can be reduced by increasing the number of count replications at each sampling point or the counting time or both. The loss of precision due to using neutron count rate ratios instead of simple count rates is negligible if several count replications are made in a standard medium or if the counting time is long enough. The rule of integration of water content profiles in order to calculate water storage has a great importance: the use of Simpson's rule drastically decreases the associated variance as compared with the classical trapezoidal method. (Murphy-IVI)
W84-04345

SIMULATING INFILTRATION INTO SAND FROM A TRICKLE LINE SOURCE USING THE MATRIC FLUX POTENTIAL CONCEPT,
Alexandria Univ. (Egypt). Dept. of Soil and Water Services.
R. Ragab, J. Feyen, and D. Hillel.
Soil Science, Vol. 137, No. 2, p 120-127, February, 1984. 7 Fig, 11 Ref.

Descriptors: *Simulation, *Infiltration, *Sand, *Matric flux potential, Trickle discharge, Simulation analysis.

The problem of defining the three-dimensional pattern of infiltration under trickle sources is of growing interest, but is geometrically complex. The problem can be simplified in the case of line sources or closely spaced emitters acting effectively as a line source. Here, the pattern of wetting can be treated as two-dimensional, horizontal and vertical, rather than three-dimensional. A simulation model was used based on the matric flux potential concept to describe two-dimensional infiltration from a line source. The model showed considerable stability with varying compartment sizes and

trickle discharges. The simulated wetting patterns indicated closer agreement with published experimental data than did alternative models, especially under high rates of trickle discharge. (Murphy-IVI)
W84-04346

SOME EXACT SOLUTIONS FOR SOLUTE TRANSPORT THROUGH SOILS CONTAINING LARGE CYLINDRICAL MACROPORES,
Agricultural Research Service, Riverside, CA. Salinity Lab.
M. T. van Genuchten, D. H. Tang, and R. Guennelon.
Water Resources Research, Vol. 20, No. 3, p 335-346, March, 1984. 3 Fig, 41 Ref.

Descriptors: *Solute transport, *Soil water, *Macropores, Mathematical equations, Diffusion, Soil matrix, Soil pores.

Large macropores can significantly influence the rate of water and solute movement in field soils, especially during conditions near saturation. Several exact and approximate analytical solutions are presented for equations describing convective-dispersive solute transport through large cylindrical macropores with simultaneous radial diffusion from the larger pores into the surrounding soil matrix. Adsorption effects were included through the introduction of linear isotherms for both the macropore region and the soil bulk matrix. In one formulation the macropores are surrounded by cylindrical soil mantles of finite thickness. Another formulation considers diffusion from a single cylindrical macropore into a radially infinite soil system. Approximate solutions are presented for the radial concentrations distribution within the adjacent soil matrix. At early times, little accuracy is lost when the radially finite soil mantle is replaced by an infinite system. For at least one set of system parameters, a simple approximation solution for the concentration in the macropore liquid phase was found to give an excellent approximation of the more complicated exact solution. This approximate solution ignores dispersion in the macropore system and also assumes that the soil matrix surrounding the macropore extends to infinity. (Moore-IVI)
W84-04358

ANALYSIS OF SOIL EXTRACTS FOR INORGANIC AND ORGANIC TRACER ANIONS VIA HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
R. S. Bowman.
Journal of Chromatography, Vol. 185, No. 3, p 467-477, March, 1984. 7 Fig, 2 Tab, 8 Ref.

Descriptors: *Tracers, *Chromatography, Soil water, Environmental tracers, Anions, Organic soils.

A high performance liquid chromatographic technique allowing simultaneous quantification of Br(-), SCN(-), I(-), and four fluorinated benzoic acid derivations in soil extracts is described. The method requires a minimal amount of sample preparation and should be suitable for analysis of other anions of interest in natural waters. Detection limits for tracer standards were in the range of 1.2 to 3.5 ng. A chromatogram for a typical tracer containing soil extract is presented. (Baker-IVI)
W84-04381

SUBSURFACE DRAINAGE EFFECTIVENESS ON ALLUVIAL SOIL,
Louisiana Agricultural Experiment Station, Baton Rouge.
R. L. Bengtson, C. E. Carter, H. F. Morris, and J. G. Kowalczuk.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 2, p 423-425, March-April, 1983. 3 Fig, 4 Tab, 6 Ref.

Descriptors: *Alluvial soils, *Subsurface drainage, Drainage, Soil water, Loam, Soil properties, Erosion, Erosion control, Louisiana, Baton Rouge, Corn, Surface runoff.

A subsurface drainage-runoff-erosion experiment on clay loam soil near Baton Rouge, Louisiana was conducted in 1980 and 1981. The experiment consisted of four plots, of which two were subsurface drained. Corn silage was grown each year. Crop yields from the surface drained plots were 10.30 and 8.36 t/ha, dry matter, for 1980 and 1981, respectively. Yields from the subsurface drained plots were 19.47 and 14.54 t/ha in 1980 and 1981, respectively, which were 89 and 74% more due to subsurface drainage. The water table on the surface drained plots was within 30 cm of the surface for 11.6 days or 11% of the season. The water table on the subsurfaced drained pots was never closer to the surface than 35 cm. Soil loss was 496.8 and 408.5 kg/ha, from surface and subsurface drained plots, respectively, for a 17.8% decrease due to subsurface drainage. (Baker-IVI)
W84-04425

SUBSURFACE DRAINAGE OF AN ALLUVIAL SOIL INCREASED SUGARCANE YIELDS,
Louisiana Agricultural Experiment Station, Baton Rouge.
C. E. Carter, and C. R. Camp.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 2, p 426-429, March-April, 1983. 3 Fig, 3 Tab, 6 Ref.

Descriptors: *Subsurface drainage, *Crop yield, Drainage, Alluvial soil, Soil properties, Soil types, Sugarcane, Louisiana.

An experiment was conducted on a 10 ha tract of Commerce silt loam in St. James Parish, Louisiana during 1977-1980 to determine the response of sugarcane to subsurface drainage. Subsurface drains 24, 36, and 48 m apart lowered the water table at about the same rate during a 4 year study. Sugarcane yields were increased significantly in 3 of 4 years by subsurface drainage and sugar yields were increased significantly 1 of 4 years. Subsurface drainage for sugarcane is economically feasible, assuming subsurface drain spacing of 48 m and a cost of $1.46/m for installing drains. (Baker-IVI)
W84-04426

REMOTE SENSING OF SOIL MOISTURE WITH MICROWAVE RADIOMETERS,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
T. Schmugge.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 3, p 748-753, May-June, 1983. 8 Fig, 2 Tab, 29 Ref.

Descriptors: *Soil water, *Remote sensing, *Microwave radiometers, Satellite technology, Aerial sensing.

Microwave radiometers measure the thermal radiation at wavelengths between 1 mm and about 50 cm that is generated within the soil volume and subsequently emitted through the surface. The fraction of this upwelling radiation incident on the soil surface that is transmitted into the air will be determined by the dielectric properties of a transition layer just below the surface. This fraction can be called the emissivity of the soil and is strongly dependent on the moisture content of the soil in this transition layer. This dependence is due to the large contrast between the dielectric properties of liquid water and those of dry soil. The large dielectric constant of water results from the electric dipole moment of the water molecule. The dielectric constant of water at the lower microwave frequencies is approximately 80 compared with 3 to 5 for dry soils; as a result, the dielectric constant of wet soils can reach values of 20 or more. This produces a range of soil emissivity from about 0.95 for dry soils to 0.6 or less for wet soils. Theoretical studies have indicated that this transition layer is on the order of a few tenths of wavelength thick, i.e., 2 to 5 cm for a 21 cm wavelength. This layer determines the primary soil moisture sampling depth, and its approximate thickness has been confirmed by observations. Results from truck, aircraft, and spacecraft platforms are presented which demonstrate the sensitivity of microwave radiometers to soil moisture variations for a wide range of conditions including light to moderate amounts of vegetative cover. (Author's abstract)
W84-04436

INFILTRATION THROUGH RECONSTRUCTED SURFACE MINED SPOILS AND SOILS,
Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4C.
W84-04445

SIMULATING THE HYDRAULIC BEHAVIOR OF A SEWAGE SLUDGE-AMENDED MINE SOIL,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Engineering.
T. M. Younos, and M. D. Smolen.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 5, p 1397-1400, September-October, 1983. 6 Fig, 1 Tab, 18 Ref, 1 Append.

Descriptors: *Soil amendments, *Sludge disposal, *Land reclamation, *Mine wastes, *Infiltration, Computer models, Simulation, Mine soils, Soil water, Strip mines, Wetting front, Soil hydraulics.

A one-dimensional, Continuous System Modeling Program (CSMP) infiltration model was validated for simulation of infiltration in a mine soil. The validated model was then used to simulate the effect of sewage sludge incorporation on the infiltration and moisture redistribution in a mine soil profile similar to that found at a reclaimed surface mine. Simulation results indicated more rapid advance of the wetting front in sludge amended mine soil as compared with unamended mine soil. The simulation predicted that 1% addition of sludge results in 1.65-fold increase in cumulative infiltration, and 5% addition of sludge results in 2.85-fold increase in cumulative infiltration during a 3 h infiltration period. Further addition of sludge over 5%, however, did not cause any additional increase in infiltration. Use of the CSMP model with measured hydraulic parameters was demonstrated as a tool to evaluate infiltration dynamics and moisture redistribution in sludge-amended mine soil. (Moore-IVI)
W84-04464

NUMERICAL FITTING OF THE GARDNER EQUATION TO HYDRAULIC CONDUCTIVITY AND WATER RETENTION DATA,
Agricultural Research Service, University Park, PA. Northeast Watershed Research Center.
J. R. Hoover, and W. J. Grant.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 5, p 1401-1408, September-October, 1983. 2 Fig, 4 Tab, 64 Ref, 1 Append.

Descriptors: *Permeability coefficient, *Unsaturated flow, *Soil water, *Water retention, Mathematical equations, Diffusivity, Computer models.

Quantitative application of the theory of unsaturated flow in porous media requires certain parameters of the site to be determined experimentally before it is possible to carry out numerical analysis of water movement in the unsaturated phase for that material. These paramenters include the moisture characteristic function and conductivity function. A procedure for forcing a least squares fit through the first data point of a Gardner-type equations to fit the moisture characteristic and hydraulic conductivity functions was developed. This method provides several measures to determine the goodness of fit. Coefficients for the Gardner equation were determined for many soils data reported in the literature. The method fit the equation to the data well as indicated by the measures of goodness of fit given in the tables. Procedures were developed to convert the length and time units if desired. Coefficients C1 and C2 are unit dependent but C3 is not. The equation for the diffusivity function was derived from the moisture characteristic and conductivity functions. These procedures plus the ease of using the Gardner solution should make it invaluable for use in nu-

merical models instead of using the conventional linear interpolation of tabular data for these functions. (Moore-IVI)
W84-04465

HYDRAULIC GRADIENTS NEAR SUBSURFACE DRAINS AND SOIL EROSION,
Rijksstation voor Landbouwtechniek, Merelbeke (Belgium).
For primary bibliographic entry see Field 8B.
W84-04466

THE PIT BAILING METHOD FOR HYDRAULIC CONDUCTIVITY MEASUREMENT OF ISOTROPIC OR ANISOTROPIC SOIL,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
H. Bouwer, and R. C. Rice.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 5, p 1435-1439, September-October, 1983. 8 Fig, 2 Tab, 5 Ref.

Descriptors: *Permeability coefficient, *Pit bailing, *Isotropic soils, *Anisotropic soils, Water table, Seepage.

With the pit bailing technique, a hole is dug (normally with a backhoe) to below the groundwater table. After equilibration, the water level in the pit is rapidly (instantaneously) lowered and the subsequent rise of the water level is measured for calculation of the hydraulic conductivity K around the pit. The pit bailing technique was originally developed for septic tank leach field design. However, the method is also useful for in-situ measurement of K for other purposes. This is particularly true for stony soils, where augerhole and other methods are difficult and often fail. Another advantage of the pit method is that the volume of soil on which K is determined is larger than for the augerhole and piezometer methods. The equation originally given for the pit method was based on the Thiem formula, which limited the method to situations where the pit bottom was at or close to the impermeable layer. The geometry of the flow system for the pit method, however, is similar to that for the piezometer method if the water table coincides with the top of the piezometer cavity. Thus, the equation for the piezometer method can also be used for the pit method. This extends the applicability of the pit method to partially penetrating pits in soils that are underlain by either impermeable or very (infinitely) permeable material. Geometry factors for the piezometer method presented by Youngs were extrapolated to the case where the static water table coincides with the top of the cavity. The resulting values then can be used for the pit method. The validity of this approach was demonstrated in a large sand tank where the average K-value yielded by pit-bailing tests on holes of various diameters and depths was 31 m/day as compared to an average value of 37 m/day obtained with one-dimensional and seepage meter methods. In anisotropic soils, K in horizontal and vertical direction can be calculated from the K values obtained from two pits with different geometries. (Author's abstract)
W84-04470

INFILTRATION PARAMETERS FROM FURROW IRRIGATION ADVANCE DATA,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
R. L. Elliott, W. R. Walker, and G. V. Skogerboe.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 6, p 1726-1731, November-December, 1983. 5 Fig, 3 Tab, 14 Ref.

Descriptors: *Infiltration, *Furrow irrigation, Irrigation, Soil water, Model studies, Kostiakov parameters, Soil compaction.

A method is presented for using dimensionless advance curves and furrow irrigation field data to derive the values of the modified Kostiakov infiltration parameters. The model incorporated zero-inertia theory, meaning that the acceleration terms in the equation of motion are neglected. By scaling the variables of the problem, the zero-inertia equations were nondimensionalized, and a set of five dimensionless parameters was derived. Two of the parameters characterize channel geometry and three parameters are functions of the constants of the modified Kostiakov infiltration equation. For a given set of values of these parameters, there is a unique curve relating dimensionless advance times and distances. Dimensionless advance was quite insensitive to the two dimensionless channel geometry parameters. Therefore these advance relationships could be presented graphically as a function of only the three dimensionless infiltration parameters. For discrete values of the infiltration exponent, families of dimensionless advance curves were generated. These curves may be used as an aid in surface irrigation design, or as a means of determining infiltration characteristics. (Baker-IVI)
W84-04481

AGRICULTURAL MANAGEMENT EFFECTS ON SOIL WATER PROCESSES; PART I: SOIL WATER RETENTION AND GREEN AND AMPT INFILTRATION PARAMETERS,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
W. J. Rawls, D. L. Brakensiek, and B. Soni.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 6, p 1747-1752, November-December, 1983. 10 Fig, 2 Tab, 34 Ref.

Descriptors: *Soil water, *Infiltration, *Tillage, Soil porosity, Soil properties, Organic matter, Water retention.

Tillage significantly alters the surface roughness and total porosity of the disturbed soil layers. A method for predicting changes in soil porosity caused by different types of tillage is developed. The base soil water retention and infiltration equation parameters can be predicted from available or estimated soil properties of percent sand and clay, and percent organic matter. The procedure as presented estimates the effects of tillage on soil porosity. The soil water retention and infiltration parameters can be modified according to the estimated porosity changes. Soil water retention values and infiltration rates and amounts can be predicted by the procedures reported. (Baker-IVI)
W84-04483

INFILTRATION AND SUBSEQUENT EVAPORATION FROM SURFACE-AGGREGATED LAYERED SOIL PROFILES UNDER SIMULATED LABORATORY CONDITIONS,
Ghent Rijksuniversiteit (Belgium). Lab. of Soil Physics, Soil Conditioning and Horticultural Soil Science.
R. Hartmann, and M. De Boodt.
Soil Science, Vol. 137, No. 3, p 135-140, March, 1984. 3 Fig, 4 Tab, 23 Ref.

Descriptors: *Infiltration, *Evaporation, *Soil profiles, *Soil surfaces, *Simulation, Simulation analysis, Soil moisture retention, Polyurea, Soil water, Soil aggregates, Soil sealants, Water conservation, Soil conditioners.

Because limited and erratic precipitation often results in low crop yields, conservation of soil water is one of the major goals for improved crop production. The soil surface condition, due to its intrinsic properties and state of tilth, can profoundly affect such basic processes as infiltration, surface runoff, evaporation, and water distribution within the profile. Improving the aggregate stability of a 2-cm deep surface layer, effected by treatment with a polyurea soil conditioner, significantly increased the water infiltration during simulated rainfall and substantially reduced the evaporation. For the same potential evaporation rate of 5 mm/day, differences in total mean water loss occurred due to different climatic conditions. For a wind speed of 5 km/h and relative humidity of 40%, water losses under untreated and treated surfaces were 50 and 38%, respectively, of the total amount of infiltrated water. With a wind speed of 15 km/h and relative humidity of 80%, water losses were 30 and 11%, respectively. (Murphy-IVI)
W84-04514

ERROR ANALYSIS IN ESTIMATING SOIL WATER CONTENT FROM NEUTRON PROBE MEASUREMENTS: 2. SPATIAL STANDPOINT,
Grenoble-1 Univ. (France).
M. Vauclin, R. Haverkamp, and G. Vachaud.
Soil Science, Vol. 137, No. 3, p 141-148, March, 1984. 4 Fig, 3 Tab, 17 Ref.

Descriptors: *Error analysis, *Soil water, *Neutron probes, Mathematical studies, Statistical analysis, Analysis of Variance, Sensors.

An analysis of variance has shown that three components are involved in estimating mean water content at a specified depth when a neutron probe is used (instrument, calibration, and location). The soil moisture was measured by two neutron probes at 17 locations regularly spaced on the field. For each probe a unique calibration curve was used for the whole field with both biased and unbiased treatments of the linear correlations. All the measurements at a specified depth were normally distributed regardless of their location, and no spatial structure has been shown for the sampling scheme. In situations of site homogeneity or a large number of sampling points, the calibration component is the greatest contribution to the total variance. It is reduced by considering the unbiased statistical treatment of the neutron probe calibration curve. For higher levels of field heterogeneity, the location component becomes the major contribution to the variance of mean values. It can be decreased by increasing the number of sampling points. Finally, the suitable number of sampling points necessary to provide mean water content values with a prescribed precision is given for the experimental site by applying the central limit theorem. (Murphy-IVI)
W84-04515

AIR AND WATER FLOW IN A SEALED, PONDED VERTICAL SOIL COLUMN: EXPERIMENT AND MODEL,
Grenoble-1 Univ. (France).
J. Touma, G. Vachaud, and J. Y. Parlange.
Soil Science, Vol. 137, No. 3, p 181-187, March, 1984. 5 Fig, 18 Ref.

Descriptors: *Air circulation, *Water flow, *Flow discharge, Vertical soil columns, *Model studies, Infiltration, Soil profiles, Soil water potential, Soil water, Soil-air-water properties, Soil permeabilities.

When considering water movement in a soil, it is generally assumed that the air present in the soil is free to escape and, therefore, has no influence on the infiltration rate. If the air is not free to escape, however, due to the presence of a shallow water table, an impermeable layer, or a lateral obstruction, a significant reduction in infiltration rates occurs. Experimental results dealing with air effects on infiltration and a model that predicts the cumulative infiltration as a function of time is presented. Air pressure reaches a constant value, independent of depth and time. The primary effect of this air pressure is to decrease the water potential at the surface and thus to reduce the infiltration rate to about one-third of its value when air is free to escape. The confined air pressure value can be predicted if permeabilities of soil to air and water are known with precision near saturation. A simple analytical model is presented, which predicts the cumulative infiltration with a good precision, if air pressure or water content at the soil surface is predicted or in practice measured directly. (Murphy-IVI)
W84-04516

CORRELATION BETWEEN THE SOIL MOISTURE REGIME AND THE CLIMATE OF THE AIR LAYER NEAR THE GROUND,
V. P. Volobuyev.
Soviet Soil Science, Vol. 15, No. 2, p 88-98, 1983. 7 Fig, 1 Tab, 11 Ref. Translated from Pochvovedeniye, No. 3, p 51-62, 1983.

Descriptors: *Soil water, *Climates, Seasonal variation, Humidity, Wetting, Soil properties, Physical properties.

Direct observational data on the water regime of soil are limited. An approach is described to determining the probable soil moisture regime from climatic data. The relationship of the soil moisture content to the relative humidity of the ground air and the wetting coefficient K were studied. The investigation was based on the data from 25 meteorological stations and data on the dynamics of soil moisture in regions of these stations. Average yearly soil moisture contents and the wetting coefficients K were compared and a correlation was found. This correlation was then tested against relative air humidity. Given meteorological data on relative air humidity and wetting coefficients for the whole year, the annual soil moisture dynamics can be confidently calculated. (Baker-IVI)
W84-04523

EFFECT OF PRIMARY CULTIVATION ON THE PERMEABILITY OF FROZEN SOILS,
V. P. Gor'kov.
Soviet Soil Science, Vol. 15, No. 2, p 99-103, 1983. 1 Fig, 4 Tab, 6 Ref. Translated from Pochvovedeniye, No. 3, p 123-127, 1983.

Descriptors: *Frozen ground, *Permeability, *Cultivation, Infiltration, Soil properties, Chernozem, Loam, Clay, Snowmelt, Runoff, Thaw, Plowing.

One of the major tasks of modern soil conservation in agriculture is to increase soil permeability during snowmelt in spring. The permeability of frozen soil is much lower than that of thawed soil. Observations made in 1977-81 of the state of the soil during snowmelt in the spring, showed that the soil thaws both from the surface and from the bottom. The state of the soil thawed from the bottom in the absence of freezing or with slight freezing from the surface differs significantly from that of the soil thawed from the surface. Obviously the greater the number of permeable patches in a field, the greater its infiltration capacity. Considering that the permeability of frozen soil depends mainly on the state of the plowed layer, one can create conditions for increasing it as early as in autumn. Permeability of the soil during snowmelt in the spring was determined largely by the flatness of the surface of a field. The less level the surface, the greater the number of permeable soil patches, and consequently, the less water will flow downslope in the form of surface runoff. This explains the differences in the magnitude of runoff from ridged and level autumn-plowed fields. The most substantial increase in the permeability of frozen soils can be achieved by artificially creating at their surface microelevations 15 to 20 cm high. These provide all the prerequisites for the formation of permeable channels in the soil without forming closed depressions. (Baker-IVI)
W84-04524

EFFECT OF IRRIGATION ON THE PHYSICAL PROPERTIES OF DARK CHESTNUT SOLONETZIC SOILS, NORTHERN CRIMEA,
For primary bibliographic entry see Field 3F.
W84-04525

EVALUATION OF SLUG TESTS IN WELLS CONTAINING A FINITE-THICKNESS SKIN,
GeoTrans, Inc., Reston, VA.
C. R. Faust, and J. W. Mercer.
Water Resources Research, Vol. 20, No. 4, p 504-506, April, 1984. 2 Fig, 2 Tab, 7 Ref. NRC contract NRC-02-81-026.

Descriptors: *Slug test, *Finite-thickness skin, *Performance evaluation, *Well hydraulics, Hydraulic conductivity, Permeability, Mathematical models.

The effects of a finite-thickness skin (low-permeability zone surrounding the well bore face) on the response of slug tests is investigated by using a numerical model and a simple analytical solution. If the possibility of well damage exists, type curves should be used with caution when analyzing slug test data. This is especially true because formation damage cannot be readily discerned from the shape of the response curves alone. If the skin has a finite thickness, type curve matches will provide estimates that may be more representative of skin hydraulic properties than the formation hydraulic properties, that is, the test is only 'seeing' the skin. Such a result could have important consequences in waste disposal applications, where an underestimate of the formation hydraulic conductivity could lead to unrealistic and optimistic travel-time calculations. Because the standard analysis of slug test data may be misleading under certain formation conditions, the development of practical curve-matching techniques for finite-thickness skins would be useful. This result is different from that obtained by using an analytical solution for a skin of infinitesimal thickness. (Murphy-IVI)
W84-04575

2H. Lakes

RELATIONSHIPS AMONG CATCHES, FISHING EFFORT AND RIVER MORPHOLOGY FOR EIGHT RIVERS IN AMAZONAS STATE (BRAZIL), DURING 1976-1978,
Universidade Federal do Maranhao, Sao Luis (Brazil).
M. Petrere, Jr.
Amazoniana, Vol. 8, No. 2, p 281-296, December, 1983. 7 Fig, 3 Tab, 20 Ref.

Descriptors: *Fisheries, *Rivers, *Morphology, *Amazonas State, *Brazil, Floodplains, Multiple regression analysis, Mathematical equations, Commercial fishing.

An equation was sought which was to be used to predict the commercial landings in Manaus (Brazil) and examine the correlations between four variables believed to determine the catches. The commercial fishery in the Amazonas State is multigear and multispecific. The rivers Negro, Branco, Purus, Jurua, Jutai, Madeira, Solimoes (+Japura) and Amazonas were selected and a multiple regression analysis undertaken to explain the annual catches landed by the fishing fleet which operates from Manaus in terms of the annual number of trips per river, the annual number of fishermen, the maximum length of the river channel, and its associated floodplain. For the eight rivers, the annual number of fishermen and dummy variables, which identify the rivers, explain 98.8% of the landings at Manaus market. Partial correlation analysis suggests that only the most productive floodplains are actively sought by professional fishermen. Any empirical model intended to predict the commercial catches in Amazonas State must take the fishing effort into consideration. (Baker-IVI)
W84-04272

SPATIAL HETEROGENEITY OF PHYTOPLANKTON IN THE LOKKA RESERVOIR, FINNISH LAPLAND,
Loughborough Univ. of Technology (England). Dept. of Human Sciences.
R. I. Jones, and V. Ilmavirta.
Annales Botanici Fennici, Vol. 20, No. 4, p 391-397, 1983. 8 Fig, 1 Tab, 28 Ref.

Descriptors: *Lokka reservoir, *Phytoplankton, *Spatial distribution, Distribution, Flagellates, Diatoms, Primary production, Chemical properties, Finnland.

Phytoplankton primary production, cell volume and species composition were studied together with some chemical parameters along two transects in Lokka reservoir during the period 16-17 July 1976. The brown water color caused rapid changes in water. Diatoms predominated in the phytoplankton in the deepest layers at the Lokka dam, but flagellates, mainly cryptophytes, were dominant at the surface. Over 50% of the total cell volume was composed of flagellates. The primary production showed a steep vertical gradient but the horizontal variation was small. (Author's abstract)
W84-04273

VERTICAL DISTRIBUTION OF BIOMASS AND SPECIES COMPOSITION OF A PERIPHYTIC COMMUNITY ON AN ARTIFICIAL SUBSTRATE IN AN OLIGOTROPHIC WATER-SUPPLY LAKE,
Lester B. Pearson Coll. of the Pacific, Victoria (British Columbia).
S. Lang, and A. Austin.
Archiv fur Hydrobiologie, Vol. 99, No. 3, p 269-286, February, 1984. 5 Fig, 1 Tab, 54 Ref.

Descriptors: *Oligotrophic lakes, *Biomass, *Periphyton, *Vertical distribution, *Species composition, Oligotrophic lakes, Distribution, Water depth.

Periphyton communities accumulating over 373 and 408 days respectively on nylon braided lines anchored vertically throughout the entire 52 m depth of an oligotrophic water supply lake showed significant biomass at considerable depth. The standing crop or biomass accumulated was assessed by three methods - air dry weight, chlorophyll-a adjusted for phaeophytin, and by species numbers and individual counts. All three methods gave values for maximum biomass between depths of 4 and 6 m with much lower values towards the surface but with appreciable growth occurring down to 10-11 m. Examination of a truncated data matrix which contained 85% of the information appeared to exhibit a pattern of distribution of species with depth revealing what could be described as four depth zones. The depth distribution of 19 species were plotted against depth to illustrate their position within the apparent depth zones observed. The data indicate, at least for clear oligotrohpic lakes, that care should be taken in selecting a depth, or depths, at which periphyton is collected or sampled using artificial surfaces, if obtaining data representative of species accumulating to maximum biomass is important. (Baker-IVI)
W84-04276

THE EFFECT OF ARTIFICIAL INFLOW ON THE 12C PRIMARY PRODUCTIVITY OF PHYTOPLANKTON IN LAKE BLED,
Ljubljana Univ. (Yugoslavia).
D. Vrhovsek, P. Stegnar, and I. Kavcic.
Archiv fur Hydrobiologie, Vol. 99, No. 3, p 287-295, February, 1984. 8 Fig, 16 Ref.

Descriptors: *Primary productivity, *Phytoplankton, *Lake Bled, *Yugoslavia, Radovna River, Alpine regions, Eutrophic lakes, Alpine lakes, Light, Water temperature.

C-12 primary productivity of phytoplankton was measured in the eutrophic alpine Lake Bled from June to November 1978. Temperature, dissolved oxygen, photosynthetically active light and the quantitative evaluation of phytoplankton were measured through the vertical profile. A summer temperature stratification was present until November when homothermia appeared. Light did not present a limiting factor for primary productivity, except during June. The highest primary productivity was in October; the lowest in July. Inflow of the Radovna considerably influenced the primary productivity mainly because of low temperatures and upwelling of bottom layers. The effect was more pronounced when differences in temperatures through the vertical profile were small. In the layers above the metalimnion primary productivity was stimulated and depressed below. Primary productivity in Lake Bled was to a greater extent influenced by inflow from the Radova, species composition, temperature and underwater light than by the amount of phytoplankton present. (Baker-IVI)
W84-04277

OPTICAL PROPERTIES OF NEW ZEALAND LAKES; I. ATTENUATION, SCATTERING, AND A COMPARISON BETWEEN DOWNWELLING AND SCALAR IRRADIANCES,
Department of Scientific and Industrial Research, Taupo (New Zealand). Div. of Marine and Freshwater Sciences.
C. Howard-Williams, and W. F. Vincent.
Archiv fur Hydrobiologie, Vol. 99, No. 3, p 318-330, February, 1984. 4 Fig, 2 Tab, 16 Ref.

Descriptors: *Lakes, *Optical properties, *New Zealand, Downwelling, Scalar irradiances, Chlorophyll, Radiation, Light, Suspended solids, Color, Turbidity.

Measurements of downward and upward photosynthetically active radiation (PAR) with a cosine-corrected quantum sensor, and scalar irradiance with a spherical quantum sensor were made on 34 optically different New Zealand lakes. From these data the extinction coefficients, the coefficient of backscattering, reflectance, and the ratio of scalar to downward irradiance were calculated. These measures were related to chlorophyll-a, total suspended solids and the amount of dissolved color in the lake water. Upwelling irradiance was high in turbid lakes and low in humic lakes. The data showed that in turbid lakes the measurements of downward irradiance can underestimate the number of quanta available to algal cells by as much as 60%. (Baker-IVI)
W84-04278

ECOLOGY OF AEROBIC HYDROGEN-OXIDIZING BACTERIA IN TWO FRESHWATER LAKE ECOSYSTEM,
Wisconsin Univ.-Madison. Dept. of Bacteriology.
B. Schink, and J. G. Zeikus.
Canadian Journal of Microbiology, Vol. 30, No. 2, p 260-265, February, 1984. 4 Fig, 26 Ref. Department of Energy grant 80EV02162.

Descriptors: *Bacteria, *Ecology, *Aerobic bacteria, *Hydrogen oxidation, *Hydrogen, *Lakes, Knallgas Bacteria, Microbial decomposition, Meromictic lakes, Holomictic lakes, Hydrogen cycling, Knaack Lake, Lake Mendota, Wisconsin.

Molecular hydrogen is produced by anaerobic microbial decompositon, photosynthetic activities or as a byproduct of biological nitrogen fixation. However, hydrogen evolution into the atmosphere and hydrogen concentrations in aquatic ecosystems are limited because of concomitant hydrogen consumption by microorganisms. Hydrogen concentration, hydrogenase activity, and numbers of aerobic hydrogen-oxidizing bacteria were measured in the water column and sediment surface of a meromictic and a holomictic lake (Lake Mendota, Knaack Lake, Wisconsin). Low but detectable concentrations of hydrogen (0-4 microL/mL) and numbers of aerobic hydrogen-oxidizing bacteria (0-50 cells/mL) were present in the upper photic zones in both lakes. Hydrogen concentrations, numbers of aerobic hydrogen-oxidizing bacteria, and hydrogenase activity were not significant in the anoxic water column or at the chemocline. Highest levels of oxygen-dependent hydrogenase activity and of aerobic hydrogen-oxidizing bacteria occurred in the hydrogen-depleted surface sediments. The prevalent strains in both lakes were characterized and assigned as species of Pseudomonas or Aquaspirillum. The data suggest that oxygen-dependent hydrogen oxidation by aerobic chemotrophs is of minor significance to hydrogen cycling in these lake ecosystems. (Murphy-IVI)
W84-04288

THE ECOLOGY OF EPIPELIC ALGAE OF FIVE WELSH LAKES, WITH SPECIAL REFERENCE TO VOLVOCALEAN GREEN FLAGELLATES (CHLOROPHYCEAE),
University Coll. of North Wales, Bangor. School of Plant Biology.
C. M. Happey-Wood, and J. Priddle.
Journal of Phycology, Vol. 20, No. 1, p 109-124, March, 1984. 11 Fig, 4 Tab, 63 Ref. Environment Research Council grant GR3-3659.

Descriptors: *Epipelic algae, *Mountain lakes, *Volvocalean, Diatoms, Blue-green algae, Population dynamics, Population density, Biological properties, Lake Llydaw, Lake Cwellyn, Lake Padarn, Lake Maelog, Lake Coron, North Wales.

The ecology of epipelic algae on the marginal sediments of five Welsh lakes was studied over an annual cycle. The lakes, Llydaw, Cwellyn, Padarn, Maelog and Coron ranged from very oligotrophic to nutrient-rich. Attention was focused on chlamydomonad flagellates, diatoms, blue-green algae and euglenoids and the different proportions of these in algae in the epipelon of lakes of contrasting water quality. A total of 75 algal taxa was found in the five lakes, 25 were species of volvocalean flagellates. Mean annual population density of these flagellates differed by an order of magnitude between the lakes. The greatest population density was recorded for Chlamydomonas anticontata Schiller in nutrient-rich Llyn Maelog. Twenty species of pennate diatoms were recorded frequently in the epipelon. In the nutrient-rich lakes, Maelog and Coron, pennate diatoms were dominant on the sediments, where they exhibited population maxima in spring and autumn. Increase in numbers of epipelic diatoms was recorded when silica concentrations were minimum in the overlying lake waters. Navicula hungarica Grun. achieved the maximum population density, 260,000 cells/sq cm. Euglenoids formed large epipelic populations during late-summer and autumn in these nutrient-rich lakes. Blue-green algae were more important, proportionally, in the nutrient-poor mountain lakes, which had sediments of higher organic content. Chlamydomonads were the major algal component of the epipelon in the mountain lakes, Llydaw and Cwellyn, where the sediments were characterized by larger particle size, and higher organic content. In the nutrient-rich lakes, where the sediments had higher calcium content, chlamydomonads formed significant populations only during spring and summer, when nutrient levels were minimal in the overlying lakewaters. (Murphy-IVI)
W84-04322

AMIDOHYDROLASE ACTIVITY IN NATURAL WATERS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
W. T. Frankenberger, Jr., and J. B. Johanson.
Polskie Archiwum Hydrobiologii, Vol. 30, No. 4, p 319-329, 1983. 6 Fig, 3 Tab, 25 Ref.

Descriptors: *Amidohydrolase activity, *Natural waters, Aquatic enzymes, Urease, Amidase, L-Asparaginase, L-Glutaminase, Hydrogen ion concentration, Chemical properties, Assay, Kinetics, Enthalpy, Cycling nutrients.

Urease, amidase, L-asparaginase, and L-glutaminase were assayed in three freshwater lakes and an oceanic water sample by utilizing urea, formamide, L-asparaginase, and L-glutamine as substrates, respectively. The activity of L-glutaminase as a function of pH increased from 6.0 to 7.0 and thereafter declined with decreasing H(+) ion concentration. Each substance exhibited similar pH dependencies (optimal pH 7-8) when measured between 6.0 and 11.0. By using the Lineweaver-Burk plot, the Km values averaged 1.1 mM for urease, 5.1 mM for amidase, 3.0 mM for L-asparaginase, and 5.9 mM for L-glutaminase. The linear relationship when 2 or less cu cm of water was used indicated that neither the substrate concentration nor the products formed influenced the reaction rates of amidohydrolases sample. However, deviations from linearity were observed when greater than 2 cu cm of water were used in the assays. This relationship was particularly evident with the higher activties of amidohydrolases as in the case of L-glutaminase and amidase. A substrate concentration of 0.1 M was satisfactory for the assay of amidohydrolase activity in surface waters by essentially following zero-order kinetics. The reaction velocity of urease, amidase, L-asparaginase, and L-glutaminase increased with increasing temperatures up to 50, 50, 60, and 60 degrees C, respectively, while further increases in temperature decreased the reaction rates. The enthalpies of activation of urease, amidase, L-asparaginase, and L-glutaminase in three freshwater lakes and an oceanic water sample averaged 40.3, 32.0 32.6, and 19.5 kJ/mole, respectively. (Murphy-IVI)
W84-04340

THE EFFECT OF PHOSPHATE ON BACTERIAL BIOMASS PRODUCTION IN WATERS OF LAKES OF THE JORKA RIVER DRAINAGE BASIN,
Polish Academy of Sciences, Lomianki. Inst. of Ecology.
For primary bibliographic entry see Field 5C.
W84-04341

BIOLOGY OF DREISSENA POLYMORPHA (PALL.) SETTLING ON STYLON NETS AND THE ROLE OF THIS MOLLUSC IN ELIMINATING THE SESTON AND THE NUTRIENTS FROM THE WATER-COURSE,
Akademia Rolnicza w Szczecinie (Poland). Dept. of Hydrozoology.
Z. Piesik.
Polskie Archiwum Hydrobiologii, Vol. 30, No. 4, p 353-361, 1983. 3 Fig, 2 Tab, 13 Ref.

Descriptors: *Dreissena, *Cycling nutrients, *Seston, Self-purification, Nutrient removal, Biofiltration, Biofilters, Oder River.

Dreissena polymorpha is the most common mollusk in our waters. It leads a settled mode of life and participates in processes of biofiltration, biosedimentation of the seston and accumulation of various mineral compounds thereby affecting conditions of the water environment. Biology of a 1-year-old population of Dreissena polymorpha settled on a stylon net barrier set in one of the downstream River Oder channels was studied. A mass settling of larval Dreissena was found to occur on the barriers from May through October. A mean density of Dreissena on the nets studied ranged from 1 530 to 448 970 indiv./sq m of net area. Only 0.3% of the bivalve survived the winter. The Dreissena settled on the nets fell prey to various predators, mainly Orconnectes limosus and Fulica atra. The bivalve living on the barriers eliminated dissolved nutrients, CaCO3, and other mineral salts from the water. (Murphy-IVI)
W84-04342

EUTROPHICATION IN PEEL INLET - III A MODEL FOR THE NITROGEN SCENARIO AND A RETROSPECTIVE LOOK AT THE PRELIMINARY ANALYSIS,
Australian National Univ., Canberra. Centre for Resource and Environmental Studies.
R. B. Humphries, G. M. Hornberger, R. C. Spear, and A. J. McComb.
Water Research, Vol. 18, No. 4, p 389-395, 1984. 5 Fig, 2 Tab, 12 Ref.

Descriptors: *Eutrophication, *Peel Inlet, Nitrogen cycle, Simulation analysis, Mathematical model, Performance evaluation, Nitrogen fixation.

The first two papers in this series described a speculative mathematical model for phosphorus dynamics in Peel Inlet, Western Australia. In this third paper of the series, the structure of and results from an a priori speculative simulation model of the nitrogen dynamics of eutrophic Peel Inlet are described. This simulation exercise indicated that nitrogen limitation of Cladophora growth rarely occurred. The results of this simulation exercise, and those of the earlier study of the phosphorus scenario, are then compared with field and laboratory data collected subsequently. This comparison indicates that the preliminary speculative simulation technique is a powerful method for the definition of the critical uncertainties in the knowledge of an environmental system, and therefore for the direction and planning of future research. Furthermore, the simulations correctly identified phosphorus, rather than nitrogen, as the major limiting nutrient for macroalgal growth in Peel Inlet. (Murphy-IVI)
W84-04348

TIME-VARIANT DIFFERENCES IN CHEMISTRY AMONG FOUR SMALL STREAMS,
P. Teti.
Water Resources Research, Vol. 20, No. 3, p 347-359, March, 1984. 1 Fig, 6 Tab, 58 Ref. National Research Council of Canada grant NRC 67-7073.

Descriptors: *Stream water, *Water chemistry, *British Columbia, Silica, Calcium, Potassium, Sodium, Magnesium, Snowmelt, Groundwater, Runoff, Lithology, Time-variance, Mountain streams.

Concentrations of the major cations and silica were monitored in four small British Columbia Coast Mountain streams during the 1976 snowmelt season. The fours streams could be grouped into three unique classes using logarithmically transformed calcium and potassium concentrations. The two most similar basins fed streams that were chemically indistinguishable. The next most similar basin yielded runoff that was chemically similar to the other two except for unusually low K(+) concentration, possibly due to a shortage of biotite in the bedrock. The fourth stream had unusually high Ca(++), Mg(++), Na(+), and silica concentrations due to the long residence time of groundwater from metamorphic rocks in its basin. Another different feature of that basin was the earlier depletion of its spring snowpack due to its south aspect. Time-variant differences in chemistry among streams were measured as changing ratios of solute concentrations over time. Differences among streams were time-variant due to time variance of interbasin runoff components. The relative contribution of groundwater increased in the basin with the metamorphic rocks and decreased in the other three basins over the summer. The chemical differences among streams were reflected in solute loads as well as solute concentrations. Therefore the major components of variable runoff and solute sources in the study area was high runoff and low solute yield from three basins on granite and low runoff but high solute yield from a basin on metamorphic rocks. (Author's abstract)
W84-04359

THE EFFECT OF TEMPERATURE ON PHOTOSYNTHETIC AND RESPIRATORY ELECTRON TRANSPORT SYSTEM ACTIVITY IN THE SHALLOW AND DEEP-LIVING PHYTOPLANKTON OF A SUBALPINE LAKE,
California Univ., Davis. Div. of Environmental Studies.
J. C. Priscu, and C. R. Goldman.
Freshwater Biology, Vol. 14, No. 2, p 143-155, April, 1984. 2 Fig, 2 Tab, 57 Ref.

Descriptors: *Lakes, *Phytoplankton, *Temperature effects, Subalpine regions, Photosynthesis, Respiration, Castle Lake, Seasonal variation.

The influence of temperature on in vivo photosynthetic and in vitro respiratory electron transport system activity was determined over the season for the 3 m and a 20 m phytoplankton community in Castle Lake. The optimum temperature of photosynthesis was significantly higher at 3 than at 20 m. Seasonally, the photosynthetic temperature optimum increased when the blue-green alga Chroococcus limneticus Lemm. was present. Temperature optima were not significantly different in experiments conducted under limiting or saturating photosynthetic photon flux densities. Respiratory electron transport system activity usually began to inactivate between 19 and 20 degrees C. These findings demonstrate that the epilimnetic and hypolimnetic phytoplankton communities in Castle Lake are physiologically distinct with regard to their temperature characteristics. (Baker-IVI)
W84-04370

CHANGES IN SEDIMENT NUTRIENT CONTENT IN A SUBARCTIC LAKE SUBJECTED TO LAKE FERTILIZATION,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
S. Bjork-Ramberg.
Freshwater Biology, Vol. 14, No. 2, p 156-163, April, 1984. 8 Tab, 15 Ref.

Descriptors: *Lakes, *Nutrients, *Lake sediments, Sedimentation, Phosphorus, Nitrogen, Denitrification, Fertilization, Lake Gunillajaure, Sweden, Stratification.

Phosphorus and nitrogen concentration in the surface sediment was analyzed before, during and after fertilization of a small, stratified, subarctic lake. During stratification 70% of the added nutrients were deposited in the epilimnion sediment. After 2 years of fertilization, there was a significant increase of both nutrients at all water depths, although values were 30-50% higher per square meter in the shallow areas. Nutrient budget calculations based on the sediment analyses showed that 75% of the added phosphorus and 45% of the nitrogen were accumulated in the sediment after fertilization. The sediment velocity in Lake Gunillajaure was found to be very low. This, in conjunction with sediment nutrient uptake experiments, indicates that the most important pathway of nutrients to the sediments is a direct uptake by the epipelic algae as the phosphate uptake capacity by the algae on the sediment is very high. Much of the phosphorus that is taken up the epipelic algae must have been excreted or released on death but still retained in the sediment. Denitrification from the sediment in Lake Gunillajaure seems to be insignificant as the sediment analyses and the mass balance calculations show such good agreement. (Baker-IVI)
W84-04371

USE OF ATP AND CARBON:NITROGEN RATIO AS INDICATORS OF FOOD QUALITY OF STREAM DETRITUS,
Guelph Univ. (Ontario). Dept. of Zoology.
B. R. Taylor, and J. C. Roff.
Freshwater Biology, Vol. 14, No. 2, p 195-201, April, 1984. 1 Fig, 3 Tab, 23 Ref.

Descriptors: *Detritus, *Streams, *Nutrients, Adenosine triphosphate, Carbon, Nitrogen, Phosphates, Decomposing organic matter, Organic matter, Temperature effects, Seasonal variation, Sediments, Stream flow.

As part of a larger study of gradients in lotic ecosystems, the biocarbon to particulate organic matter ratio (BIOC/POM) and C/N ratios of suspended and benthic stream detritus were assessed along three physically different streams in order to ascertain how these parameters changed with downstream distance, and which physical features were associated with these changes. Large differences in sediment adenosine triphosphate (ATP) fractions between upstream and downstream Hanlon Creek reflect the upstream allochthonous inputs of woody material, while the downstream reaches receive conditioned material. Sediment ATP fractions in Blue Springs Creek were comparable to upstream Hanlon Creek which has similar organic inputs. The high water temperatures in the Speed River probably account for the high ATP levels of sediments found there. Sediment ATP appears to be a valuable and sensitive indicator of changes in detritus food quality between reaches or through time in these headwater streams. C/N ratios of sediments showed much the same pattern of differences as ATP but were less variable. By contrast, the ATP content and C/N ratios of suspended organic matter showed no systematic variation between upstream and downstream or between warmer open and cooler shaded areas, probably due to the very short residence time of suspended particles. (Baker-IVI)
W84-04374

ORGANIC GEOCHEMISTRY OF SUSPENDED AND SETTLING PARTICULATE MATTER IN LAKE MICHIGAN,
Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
P.A. Meyers, M. J. Leehneer, B. J. Eadie, and S. J. Maule.
Geochimica et Cosmochimica Acta, Vol. 48, No. 3, p 443-452, March, 1984. 4 Fig, 4 Tab, 46 Ref.

Descriptors: *Lakes, *Particulate matter, Geochemistry, Suspended solids, Sediments, Lake sediments, Carbon, Nitrogen, Fatty acids, Alkanols, Sterols, Aliphatic hydrocarbons, Sediment-water interfaces, Lake Michigan.

Organic matter contained in particulate matter in Lake Michigan waters and sediments has been characterized by C/N ratios and by distributions of biomarker fatty acids, alkanols, sterols, and aliphatic hydrocarbons. Differences in the amount and types of geolipids present in particulate matter found at different depths in Lake Michigan suggest a complex interplay of organic matter production alteration, and destruction which accompanies the settling of sediment particles through the water. Suspended particulates in the top meter of the open lake waters contain a major component of terrigenous lipid matter brought to these locations by eolian transport. Settling particles in the metalimnion contain predominantly aquatic lipid matter. Organic matter associated with sinking particles undergoes substantial degradation during sedimentation in Lake Michigan. Aquatic lipid components are selectively destroyed relative to the terrigenous components of this oganic material. Petroleum hydrocarbons are associated with particles collected in sediment traps in the metalimnion but not with shallower or deeper particles, evidently as a result of density segregation of settling particles. Resuspension of surficial sediments causes selective removal of finer fractions from the lake bottom and corresponding enrichment of bottom nepheloid layers with these sediment size classes. Because aquatic lipid matter is preferentially associated with the fine fractions, nepheloid particulate matter has an aquatic biomarker character, whereas bottom sediments have a terrigenous character. (Baker-IVI)
W84-04379

RELATIONSHIPS BETWEEN ZOOPLANKTON ABUNDANCE AND CHLOROPHYLL A CONCENTRATIONS IN FLORIDA LAKES,
Florida Univ., Gainesville. Inst. of Food and Agricultural Sciences.
D. E. Canfield, Jr., and C. E. Watkins.
Journal of Freshwater Ecology, Vol. 2, No. 4, p 335-344, April, 1984. 1 Fig, 3 Tab, 20 Ref.

Descriptors: *Zooplankton, *Lakes, Florida, Chlorophyll, Limnology, Cladocerans, Copepods, Crustaceans, Rotifers, Seasonal variation, Eutrophication.

Data collected during a limnological survey of 165 Florida lakes were used to examine statistical relations between chlorophyll a concentrations and the abundance of total zooplankton, cladocerans, copepods, crustaceans, and rotifers. Significant positive correlations were found between chlorophyll a concentrations and total zooplankton abundance for both the spring and summer collection periods as well as for the overall collection period. With the exception of summer caldoceran abundance, there were also positive relationships between chlorophyll concentrations and the abundances of the other groups of zooplankton. Therefore increased chlorophyll concentrations should generally result in increased zooplankton abundance in Florida lakes. (Baker-IVI)
W84-04383

EFFECTS OF MULTIPHASE RESTORATION, PARTICULARLY ALUMINUM SULFATE APPLICATION, ON THE ZOOPLANKTON COMMUNITY OF A EUTROPHIC LAKE IN EASTERN WASHINGTON,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 6G.
W84-04386

THE CHARACTERISTICS OF AMMONIUM AND NITRATE UPTAKE BY PHYTOPLANKTON IN LAKE KINNERET,
Kinneret Limnological Lab., Tiberias (Israel).
T. Berman, B. F. Sherr, E. Sherr, D. Wynne, and J. J. McCarthy.
Limnology and Oceanography, Vol. 29, No. 2, p 287-297, March, 1984. 6 Fig, 4 Tab, 51 Ref.

Descriptors: *Nitrate, *Lakes, *Phytoplankton, Lake Kinneret, Seasonal variation, Diurnal variation, Ammonia, Eutrophication.

Seasonal and diurnal patterns of NH4(+) and NO3(-) uptake were determined for Lake Kinneret phytoplankton. In most cases a higher uptake of NH4(+) and NO3(-) was noted among nanoplankton when compared to plankton. Ammonium was always taken up preferentially and the phytoplankton had lower apparent affinity constants for this ion than for NO3(-). When the ambient levels of NH4(+) were low and those of NO3(-) were high,

as during the annual dinoflagellate bloom of Peridinium in February through May, a considerable portion of the total N flux was derived from NO3(-). Changes in light intensity account to some degree for the observed daily fluctuations of specific uptake rates for both NH4(+) and NO3(-). The findings that NO3(-) was used by the dinoflagellates implied that control of the amounts of this nutrient could be important in limiting eutrophication in Lake Kinneret. (Baker-IVI)
W84-04390

THE RELATIVE IMPORTANCE OF BACTERIOPLANKTON AND PHYTOPLANKTON IN PHOSPHOROUS UPTAKE IN FRESHWATER,
McGill Univ., Montreal (Quebec). Dept. of Biology.
D. J. Currie, and J. Kalff.
Limnology and Oceanography, Vol. 29, No. 2, p 311-321, March, 1984. 3 Fig, 2 Tab, 62 Ref.

Descriptors: *Bacteria, *Phytoplankton, *Phosphorus, Natural waters, Lakes, Nutrients, Limnology, Lake Memphremagog.

The hypothesis that bacteria rather than phytoplankton are responsible for most P uptake in situ was tested in Lake Memphremagog by means of size fractionation of P-32 orthophosphate uptake, C-14 glucose uptake and both C-14 bicarbonate uptake and chlorophyll a. In biweekly samples from May to October, particles smaller than 3.0 micrometers accounted for 72-98% of the uptake of orthophosphate. There was no diel variation in the fraction of uptake by particles smaller than 3.0 micrometers. The bacterial contribution to the total community uptake of orthophosphate was estimated to range between 97 and 100% overall samples collected. However, the phoshorus released was taken up almost entirely by the phytoplankton. The bacterioplankton apparently strongly dominates orthophosphate cycling in situ, while the phytoplankton seems to obtain most of its phosphorus from excreted organic P compounds. It remains to be determined how the algae get their phosphorus, if not from orthophosphate, and where the phosphorus goes after it is absorbed by the bacteria. (Baker-IVI)
W84-04391

THE IMPACT OF UNCERTAINTIES IN HYDROLOGIC MEASUREMENT ON PHOSPHORUS BUDGETS AND EMPIRICAL MODELS FOR TWO COLORADO RESERVOIRS,
Geological Survey, Denver, CO.
J. W. LaBaugh, and T. C. Winter.
Limnology and Oceanography, Vol. 29, No. 2, p 322-339, March, 1984. 8 Fig, 2 Tab, 47 Ref.

Descriptors: *Phosphorus, *Reservoirs, Colorado, Hydrologic budget, Groundwater flow, Watersheds, Chemical analysis, Model studies.

Water budgets and related chemical budgets of aquatic ecosystems commonly are interpreted without reference to uncertainties resulting from errors of measurement. The importance of such uncertainties in the use and interpretation of the phosphorus budgets of two Colorado reservoirs was determined. Water budgets were calculated from data from on-site measurement of precipitation, evaporation, reservoir stage, outflow, and inflow from the major river of each reservoir. Direction of groundwater flow was determined with existing well information and seepage meters. Contributions of ungauged watersheds and groundwater were estimated from the residual of measured water budget terms. The need to measure each component of a water budget with a least error method for the residual of a budget to have any hydrologic meaning was demonstrated. The residual term of the water budget, commonly used to estimate contributions from unmeasured components, could be accounted for almost entirely by measurement error. This can occur even in systems dominated by a hydrologic component that can be measured with minimal error, such as the streamflow measurements reported here. Errors in measurement of loading can be equal to, or exceed, the model error of an empirical model, particularly when the residual term of the water budget accounts for most of the loading. Using most empirical models in attempts to assess or manage the nutrient input of a water body whose loading is attributed mostly to a residual of a budget would result in a large degree of uncertainty. (Baker-IVI)
W84-04392

THE SIGNIFICANCE OF DESMIDS AS INDICATORS OF THE TROPHIC STATUS OF FRESHWATERS,
Amsterdam Univ. (Netherlands). Hugo de Vries Lab.
P. F. M. Coesel.
Schweizerische Zeitschrift fur Hydrologie, Vol. 45, No. 2, p 388-393, March, 1984. 18 Ref.

Descriptors: *Desmids, *Bioindicators, *Trophic level, Netherlands, Natural waters, Primary productivity, Alkalinity, Chlorophyta.

The presence of the chlorophycean group of the Desmidiaseae is usually supposed to be associated with an oligotrophic environment. In most plankton quotients, including the 'compound index' which is the most popular one, the desmids appear in the denominator of the fraction as being representative of the oligotrophic side of the trophic range. Reports concerning the ecological demands of desmids are compared with results obtained from studies of various habitat types in the Netherlands, to determine the significance and usefulness of desmids as indicators of trophic level. Ecological conditions under which a well-developed desmid flora can be found indicate a low productive environment to be the primary requirement. The low electrolyte content (conductivity <100 micro S/cm) and low alkalinity (HCO3(-) <0.5 meq/l) regularly associated with an oligotrophic habitat do not appear to be essential. The richest desmid assemblies were encountered at sites with moderately high electrolyte contents, especially in situations with some spatial (habitat differentiation) or temporal (niche differentiation) variation. (Baker-IVI)
W84-04398

LIGHT, STRATIFICATION AND ZOOPLANKTON AS CONTROLLING FACTORS FOR THE SPRING DEVELOPMENT OF PHYTOPLANKTON IN LAKE CONSTANCE,
Konstanz Univ. (Germany, F.R.). Limnological Inst.
U. Sommer.
Schweizerische Zeitschrift fur Hydrologie, Vol. 45, No. 2, p 394-404, March, 1984. 4 Fig, 1 Tab, 14 Ref.

Descriptors: *Phytoplankton, *Population dynamics, *Lake Constance, *Stratification, *Light, *Zooplankton, Seasonal variation, Eutrophication, Algal growth.

The patterns of phytoplankton growth and decline during the spring bloom and the following clearwater phase in Lake Constance have been studied on the basis of cell counts with short-term sampling intervals. Attempts are made to explain the patterns of increase and decrease of the four dominant algal species Rhodomonas lens, Rhodomonas minuta, Cryptomonas ovata, and Stephanodiscus hantzcchii by the antagonistic influence of a single growth factor (light) and a single loss factor (zooplankton grazing). Rapid algal growth did not start before the lake became stratified at the start of April. A bad weather period at the end of April partially destratified the lake, causing a marked decrease in phytoplankton biomass. At the end of May, heavy zooplankton grazing reduced algal crops to levels similar to those before the spring bloom, leading to the well-known clearwater phase which lasted until late June. The antagonism of only two factors, light and zooplankton pressure, is sufficient to explain phytoplankton dynamics in the spring phase of Lake Constance. Therefore, other environmental factors are of only minor importance. (Baker-IVI)
W84-04399

EQUILIBRIUM APPROACHES TO NATURAL WATER SYSTEMS - PART 3,
Umea Univ. (Sweden). Dept. of Inorganic Chemistry.
J. Liden.
Schweizerische Zeitschrift fur Hydrologie, Vol. 45, No. 2, p 411-429, March, 1984. 10 Fig, 34 Ref.

Descriptors: *Lakes, *Iron, *Ice, Ice cover, Diffusion, Natural waters, Hypolimnion, Transport.

The concentrational control of Fe(2+) has been studied in the anoxic hypolimnion of an ice covered lake with special reference to redox equilibria with the suspended phase. A comparison between the two anoxic hypolimnion formed during summer and winter in Lake Lovosundet shows that although the chemistry in qualitative terms is similar, that is, the release of Fe(2+), Mn(2+), and HCO3(-), the different processes are not quantitatively equal. The vertical distribution of species such as Fe(2+) within the anoxic water column is determined mainly by the hydrodynamical and diffusional processes. No single and truly thermodynamical redox level existed in the anoxic water column. (Baker-IVI)
W84-04400

LIMNOLOGICAL STUDIES ON THE EUTROPHICATION OF LAKE WOLDERWIJD, A SHALLOW HYPERTROPHIC OSCILLATORIA DOMINATED LAKE IN THE NETHERLANDS,
Rijksdienst voor de Ijsselmeerpolders, Lelystad (Netherlands).
C. Berger, and A. Bij de Vaate.
Schweizerische Zeitschrift fur Hydrologie, Vol. 45, No. 2, p 458-479, March, 1984. 9 Fig, 7 Tab, 50 Ref.

Descriptors: *Lakes, *Phytoplankton, Lake Wolderwijd, Seasonal variations, Nutrients, Phosphorus, Algae, Limnology, Eutrophication, Netherlands.

Lake Wolderwijd has an area of 2700 ha, mean depth of 1.5 m, residence time of 0.9 year, phosphorus load of 0.5 - 1.5 g/Psq m/yr. Phytoplankton was dominated by the blue-green alga Oscillatoria agardhii Gom. which formed a persistant bloom. Two other blue-green algae species, O. redekei v. Goor and Aphanizomenon flos-aquae (L.) Ralfs, were important in part of the year. Mean light intensity and temperature are main factors governing the competition between the algae species. Phytoplankton biomass reached summer maxima of 30 to 40 mg/l ash free dry weight. Biomass in winter was only 50% lower, on chlorophyll-a basis only 35%. The annual courses of concentration of nutrients, organic substances, part P, part N, part C, chlorophyll-a and ash-free dry weight are given beside the annual averages and correlation factors between the several biomass parameters. The features of the lake form, together with sufficient nutrients, an environment where self-regulation, via biomass, is possible to a high degree. (Baker-IVI)
W84-04401

SIZE-FRACTIONATION OF ALKALINE PHOSPHATASE ACTIVITY IN LAKE WATER BY MEMBRANE FILTRATION,
Oklahoma State Univ., Stillwater. Dept. of Microbiology.
D. A. Francko.
Journal of Freshwater Ecology, Vol. 2, No. 3, p 305-309, December, 1983. 3 Tab, 17 Ref.

Descriptors: *Lakes, *Phosphates, *Membrane filters, Filtration, Oklahoma, Sangre Isle Lake, Algae.

Alkaline phosphatase activity present in the surface waters of five north central Oklahoma lakes was partitioned into four size classes by membrane filtration. The 1.2 micro m membrane filters retained 0-86% of the total APA. Filters of 0.45 micro m size retained only slightly more APA than 1.2 micro m filters and less than 6% of any APA in the lakewater samples was able to pass through a 0.22 micro m filter. Dissolved calf APA was not retained to any appreciable extent by any of the membrane filters used. The algae genera present in

waters from these lakes during the study period were retained by the 1.2 micro m filters, as were visible bacteria in about the 1-2 micro m size class. Great homogeneity was apparent in the sources of APA in lake water. In some lakes, algal APA may predominate while in other systems, bacterial or dissolved APA may comprise the bulk of APA. (Baker-IVI)
W84-04402

REGIONAL APPLICATION OF AN INDEX OF BIOTIC INTEGRITY BASED ON STREAM FISH COMMUNITIES,
Illinois Univ. at Urbana-Champaign. Dept. of Ecology, Ethology and Evolution.
K. D. Fausch, J. R. Karr, and P. R. Yant.
Transactions of the American Fisheries Society, Vol. 113, No. 1, p 39-55, January, 1984. 9 Fig, 3 Tab, 43 Ref. EPA grants R-806391 and CR-810745.

Descriptors: *Index of biotic integrity, *Fish, *Biological communities, *Stream biota, Watersheds, Aquatic habitats, Species composition.

The recently proposed index of biotic integrity (IBI) was evaluated for several watersheds throughout the midwestern United States. Five of the community metrics comprising the IBI depend on the number of fish species present and must be adjusted for changes in expected species richness with stream size or zoogeography. We use basic relationships of fish species richness versus stream size, calculated from historical fish community data for seven watersheds, to define lines of maximum species richness. These lines are used to predict attributes of 'excellent' fish communities, the basis of comparison for assigning scores to 5 of 12 IBI metrics. When zoogeographic and stream-size factors were accounted for in assigning scores, the IBI accurately reflected watershed and stream conditions. As partial tests of the IBI, we found that the index conforms to knowledge of biologists familiar with several watersheds, is independent of stream order in homogeneous watersheds, and is not biased upwards in generally degraded watersheds. Furthermore, analysis of undisturbed fish communities in Illinois and Kentucky support criteria set for percentages of omnivorous individuals and insectivorous cyprinids expected in 'excellent' fish communities. Comparison of maximum species richness lines reveals two groups of similar fish communities, those in woodland streams (Illinois, Michigan, and Kentucky) and those in Great Plains streams (Nebraska, North and South Dakota). We suspect similarities result from ecological factors relating to physical habitat and biotic interactions, rather than from factors such as geologic and climatic history. (Author's abstract)
W84-04414

THE INFLUENCE OF NUTRIENT AVAILABILITY ON THE ECOSYSTEM BEHAVIOUR OF A SALT WATER LAKE,
Waterloopkundig Lab., Delft (Netherlands).
I. de Vries, and M. F. Veul.
Water Science and Technology, Vol. 16, No. 1/2, p 121-130, 1984. 6 Fig, 2 Tab, 10 Ref.

Descriptors: *Saline water, *Lakes, *Nutrients, Silicon, Nitrogen, Phosphorus, Primary production, Mineralization, Phytoplankton, Detritus, Decomposing organic matter, Denitrification.

The influence of the availability of silicon, nitrogen and phosphorus on the behavior of the ecosystem in the salt Lake Grevelingen is evaluated. Dynamic calculation of detritus formation resulting from mortality of phytoplankton and microphytobenthos was used to quantify nutrient cycling. Mineralization as a function of temperature and substrate concentration was also included in the calculations. During the summer portion of the year silicon and nitrogen are reversibly mixed in bottom detritus. This implies that primary production depends on the balance between accumulation of detritus in the bottom and mineralization. In contrast, the dynamics of phosphorus depend only to a minor extent on primary production and net loading. The net yearly load of nitrogen equals the amount of nitrogen present in the waterphase during the winter time. From a management point of view, stratification inhibits denitrification and should therefore be avoided. (Baker-IVI)
W84-04499

TURBIDITY CURRENTS: MONITORING THEIR OCCURRENCE AND MOVEMENT WITH A THREE-DIMENSIONAL SENSOR NETWORK,
California Univ., Los Angeles. Dept. of Geography.
F. H. Weirich.
Science, Vol. 224, No. 4647, p 384-387, April, 1984. 3 Fig, 6 Ref.

Descriptors: *Turbidity currents, *Three-dimensional sensor, Water currents, Glacial lakes, Optical sensors, Thermal sensors, Sensors, Underflow, Surges, Dynamics, Flow pattern, Erosion, British Columbia.

The general laws describing the movement of turbidity currents have been the subject of considerable study. Yet the collection of field data on such phenomena in differing environments has been limited to measurements over relatively short time spans and at only a few measurement points. Detailed field data on the occurrence, flow pattern, and internal dynamics of both surge and continuous turbidity currents have been obtained with a three-dimensional array of optical and thermal sensors. The array, operated in a glacial lake in southeastern British Columbia, collected detailed information on the character of surge events with velocities reaching 110 centimeters per second and continuous underflows exceeding 90 centimeters per second. The findings (i) indicate that such currents are frequent events, occurring with density differences between the incoming stream water and the lake water as low as 0.19 kilogram per cubic meter of water; (ii) document the differences in the initiation and internal characteristics of the continuous and surge events; and (iii) support the concept of erosion by turbidity currents. (Murphy-IVI)
W84-04535

GEOTHERMAL RESERVOIR SIMULATION USING NONEQUILIBRIUM THERMODYNAMICS,
Princeton Univ., NJ.
For primary bibliographic entry see Field 2A.
W84-04536

MEASUREMENTS OF DIEL RATES OF BACTERIAL SECONDARY PRODUCTION IN AQUATIC ENVIRONMENTS,
Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
B. Riemann, and M. Sondergaard.
Applied and Environmental Microbiology, Vol. 27, No. 4, p 632-638, April, 1984. 6 Fig, 4 Tab, 26 Ref.

Descriptors: *Measuring instruments, *Bacteria, *Secondary productivity, *Aquatic environments, Aquatic productivity, Thymidine, Analysis of variance, Biological properties, Diel studies, Denmark.

Particulate and dissolved organic matter in lakes is mainly decomposed by bacteria. To estimate the rates of metabolism and amounts of organic matter metabolized by aquatic bacteria, it is useful to determine bacterial production. During the last few years, several new methods have been developed, particularly those based on (H-3)thymidine incorporation into DNA. Measurements of bacterial secondary production were carried out during 13 diel studies at one coastal marine station and in five lakes differing with respect to nutrient concentration and primary production. Bacterial secondary production was measured in situ every 3 to 5 h by (H-3)thymidine incorporation into DNA. In some of the diel studies, these results were compared with results obtained from dark CO2-14 uptake and frequency of dividing cells. Only minor diel changes were observed. The rate of (H-3)thymidine incorporation into DNA and the frequency of dividing cells varied from 23 to 194% of the diel mean. The dark CO2 uptake rate varied from 12 to 259% of the diel mean. An analysis of variance demonstrated that no specific time periods during 24 h showed significantly different production rates, supporting the idea that bacterial activities in natural assemblages are controlled by a variety of events. The best correction (r sq = 0.74) was obtained between the (H-3)thymidine incorporation and frequency of dividing cells procedures from the lake water samples. The actual production rates calculated by (H-3)thymidine incorporation into DNA were appreciably lower than those obtained by the frequency of dividing cells and the dark CO2 uptake techniques. Diel rates of bacterial production are discussed in relation to sampling frequency, statistical errors, and choice of method. (Murphy-IVI)
W84-04538

MICROBIAL BIOMASS AND UTILIZATION OF DISSOLVED ORGANIC MATTER IN THE OKEFENOKEE SWAMP ECOSYSTEM,
Georgia Univ., Athens. Inst. of Ecology.
R. E. Murray, and R. E. Hodson.
Applied and Environmental Microbiology, Vol. 47, No. 4, p 685-692, April, 1984. 1 Fig, 5 Tab, 34 Ref.

Descriptors: *Microbial biomass, *Dissolved organic matter, *Okefenokee Swamp, Aquatic ecosystem, Biological properties, Microbial degradation, Microbiological studies, Biomass, Bacteria, Food chains.

The Okefenokee Swamp exhibited levels of microbial biomass and aerobic glucose uptake comparable to those of other organically rich, detritus-based aquatic ecosystems. In contrast to other peat-accumulating systems, this acidic (pH 3.7), low-nutrient environment does not show diminished water column or surface sediment microbial biomass or heterotrophic activity. The total particular ATP varied between 0.03 and 6.6 microg/liter (mean, 1.6 microg/liter) in water and between 1 and 28 microg/g (dry weight), the mean being 10.0 microg/g(dry weight), in sediments. The turnover times for dissolved D-glucose were 1.26 to 701.25 h (mean, 110.25 h) in aerobic waters and 2.4 to 72 min (mean, 10.2 min) in aerobic surface sediments. Water column bacterial secondary production, measured as the incorporation of (H-3)thymidine into cold-trichloroacetic acid-insoluble material, ranged from 0.06 to 1.67 nmol/liter/day (mean, 0.45 nmol/liter/day). The kinetics of D-glucose uptake by water column microflora are multiphase and suggest the presence of a diverse microbial population capable of using labile substrates at nanomolar concentrations and at substantial rates. The presence of a large and active aerobic microbial community in the Okefenokee Swamp is indicative of an important role for microbes in swamp geochemistry and strongly suggests the existence of a detritus-based food web. (Author's abstract)
W84-04539

SIGNIFICANCE OF ALGAL EXCRETORY PRODUCTS FOR GROWTH OF EPILIMNETIC BACTERIA,
Wisconsin Univ.-Madison. Dept. of Bacteriology.
T. D. Brock, and J. Clyne.
Applied and Environmental Microbiology, Vol. 47, No. 4, p 731-734, April, 1984. 2 Tab, 21 Ref. NSF grant DEB-8212459.

Descriptors: *Algae, *Epilimnetic bacteria, Bacteria, Growth, Dissolved organic carbon, Aquatic ecosystems, Phytoplankton, Excretion, Growth media, Lake Mendota, Wisconsin.

Dissolved organic carbon (DOC) may serve as a primary growth substrate for free-living bacteria in aquatic systems. The DOC pool in lakes has several sources: runoff from the land, defecation by aquatic animals, lysis of plankton cells, and excretion by phytoplankton. Light-stimulated uptake of CO2-14 and differential filtration through Nucleopore filters were used to estimate the significance of phytoplankton excretion as a source of bacterial carbon in water samples collected at different seasons of the year in Lake Mendota, Wis. On an

animal basis, about 14% of the estimated bacterial production was accounted for by algal excretion, although at certain times of year the fraction of bacterial carbon derived from algal excretion was considerably higher. About 20% of the annual primary production was estimated to pass through the bacterial component. (Murphy-IVI)
W84-04540

DYNAMICS OF THE VOLATILE ORGANIC SUBSTANCES ASSOCIATED WITH CYANOBACTERIA AND ALGAE IN A EUTROPHIC SHALLOW LAKE,
Tuebingen Univ. (Germany, F.R.). Inst. fuer Chemische Pflanzenphysiologie.
F. Juttner.
Applied and Environmental Microbiology, Vol. 47, No. 4, p 814-820, April, 1984. 6 Fig, 1 Tab, 27 Ref.

Descriptors: *Volatile organic matter, *Cyanobacteria, *Algae, Eutrophic lakes, *Dynamics, Organic matter, Chemical properties, Biological properties, Bacteria, Correlation analysis.

Volatile, low-molecular-weight organic compounds liberated by cyanobacteria and algae into surface waters are regarded as the causative agents of the odor and taste problems arising during water purification and fish breeding. The volatile substances present in a eutrophic shallow lake were determined qualitatively and quantitatively during the growing season, allowing a first-time analysis of the dynamics of these compounds in a water body. The major compounds found were beta-cyclocitral, alpha-cyclocitral, beta-ionone, 1,3,3-trimethylcyclohexene, 2,2,6-trimethylcyclohexanone, 2,6,6-trimethylcyclohex-2-en-1-one, eucalyptol, geosmin, two argosmin isomers, pent-1-en-3-ol, pent-1-en-3-one, heptadex-1-ene, heptadec-cis 5-ene, heptadeca-1, cis 8-diene, decanal, and hexanal. Most of the substances have not been detected before in natural waters. The occurrence of geosmin, the argosmin isomers, heptadec-cis 5-ene, and an unknown sesquiterpene could clearly be correlated with the appearance of Aphanizomenon gracile, as could the occurrence of beta-cyclocitral with the appearance of Microcystic wesenbergii. The data presented indicate that a rapid metabolism or the elimination of these compounds occurs in lake water. (Murphy-IVI)
W84-04541

A METHOD FOR COMPARING SCALAR IRRADIANCE MEASUREMENTS WITH UPWARD AND DOWNWARD IRRADIANCE IN LAKES,
R. H. Spigel, and C. Howard-Williams.
Water Resources Research, Vol. 20, No. 4, p 507-509, April, 1984. 5 Fig, 6 Ref.

Descriptors: *Comparison studies, *Irradiation, *Lakes, *Scalar irradiance, *Downward irradiance, *Upward irradiance, Photosynthesis, Mathematical equations, Solar radiation, New Zealand.

The distribution of solar radiation in water is one of the most important factors controlling biological and physical processes in lakes. Primary production is often limited by the light available to photosynthesizing organisms, while the depth of the wind mixed layer and the stability of the thermocline are sensitive to light extinction properties of the water. A method is outlined for comparing measurements of scalar irradiance, as measured with a 4 pi scalar irradiance meter, with downward and upward irradiance, as measured with a cosine-corrected flat plate irradiance meter. The method may prove useful when measurements of only one of these quantities are available and estimates of the other are required. The method is based on an empirical formulation of the asymptotic radiance distribution and hence is strictly valid only at the asymptotic state when the radiance distribution is symmetric about the vertical axis. In addition, some caution is needed when applying this method to lakes with high levels of suspended colloidal particles. (Murphy-IVI)
W84-04576

STOCHASTIC REPRESENTATION OF A HYPEREUTROPHIC LAKE,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
C. E. Mericas, and R. F. Malone.
Journal of Environmental Engineering, Vol. 110, No. 2, p 312-324, April, 1984. 4 Fig, 2 Tab, 14 Ref.

Descriptors: *Stochastic process, *Hypereutrophic lake, Mathematical models, Eutrophication models, Vollenweider model, Lake management, Management planning, Lake morphology, Load distribution, Water quality, Lake restoration, Model studies, Crest Lake, Louisiana.

Variability in total phosphorus concentrations in a small hypereutrophic lake are represented by a stochastic modification to the basic Vollenweider model. Uncertainties arising from the definition of initial conditions and a lumped white noise parameter are used to project probability distributions of mean in-lake total phosphorus concentrations. The resulting distributions of mean phosphorus values are modified by consideration of uncertainties associated with monitoring programs to permit comparison with the monitoring results. The model is calibrated using the results of an intensive monitoring program which included nearly five hundred total phosphorus observations from Crest Lake in southeastern Louisiana. The model is also compared against the results of a routine monitoring program. Calibration results indicate the potential usefulness of this modeling approach. (Author's abstract)
W84-04595

SNAIL MARISA CORNUARIETIS IN TROPICAL HYDROELECTRIC RESERVOIRS,
World Health Organization, New York. Blue Nile Project in Sudan.
W. R. Jobin, and A. Laracuente.
Journal of Environmental Engineering, Vol. 110, No. 2, p 356-368, April, 1984. 3 Fig, 10 Tab, 3 Ref. Department of Energy contract EY-76-C-05-1883.

Descriptors: *Snails, *Marisa, *Hydroelectric reservoirs, *Tropic zone, Water quality control, Bilharzia control, Bilharzia, Schistosomiasis, Puerto Rico.

For 3 years, populations of Marisa cornuarietis, the ampullarid snail used in bilharzia control, were monitored in 28 hydroelectric and multi-purpose reservoirs in Puerto Rice to establish the habitat requirements for this biological control agent. The information can be used to estimate the fate of this ampullarid snail if it is introduced into hydroelectric reservoirs in other countries. The major factors determining habitat suitability were water temperature, the area of submerged shore which supported vegetation, and the rate or recession of the reservoir level. The ampullarid had established itself in 22 of the 28 reservoirs. (Author's abstract)
W84-04596

A PRELIMINARY INVESTIGATION OF THE RHONE RIVER PLUME IN EASTERN LAKE GENEVA,
Geneva Univ. (Switzerland). Dept. of Geology.
J. Dominik, D. Burrus, and J.-P. Vernet.
Journal of Sedimentary Petrology, Vol. 53, No. 1, p 0159-0163, March, 1983. 3 Fig, 11 Ref.

Descriptors: *Plumes, *Suspended sediments, *Rhone River, *Lake Geneva, Turbidity, Echosounder, Entrainment, Stratification, Sediment transport, Coriolis force, Water circulation.

The Rhone River entering Lake Geneva during summer stratification preserves its identity for a long distance from the river mouth. Its waters flow at the equilibrium depth determined by temperature and amount of dissolved and particulate matter. The flow path of the suspension-loaded water results from the interaction of the influx-induced circulation and Coriolis force and is modified by wind-induced lake circulation. The high concentration of particulate matter in the turbid layer at a water depth of 10 to 30 m makes the rapid determination of its areal distribution with the echosounder possible. Once identified, physical parameters of the turbid layer can be studied in detail and sampling of the suspended matter carried out in the most efficient way. This particular survey covered about 46 sq km of the lake. The depth of the reflecting horizon on the echosounder corresponds to the upper surface of the turbidity layer, and the intensity of signal depended on turbidity gradient rather than on the absolute value of the turbidity. The thickness of the turbid layer decreased with distance from the Rhone mouth. At nearly all stations the plume was well defined with steep gradients in turbidity both above and below the concentration maximum. (Baker-IVI)
W84-04605

CHEMICAL COMPOSITION OF SURFACE SEDIMENTS IN A EUTROPHIC LAKE: NAINI TAL (UP, INDIA),
Kumaun Univ., Naini Tal (India). Dept. of Zoology.
P. K. Gupta, and M. C. Pant.
Environmental Pollution (Series B), Vol. 6, No. 2, p 95-107, 1983. 7 Fig, 1 Tab, 12 Ref.

Descriptors: *Chemical composition, *Surface sediments, *Eutrophic lake, *Naini Tal Lake, *India, Sediments, Organic matter, Mud-water interfaces, Anoxic conditions.

Important chemical constituents (NO3-N, available P, Ca, Na, K, Mn, Cu, Zn, Co and organic matter) together with pH, Eh and clay content of surface sediments at various depths of the overlying water in Lake Naini Tal were examined during 1977-78. In addition, NH3-N and dissolved oxygen at the mud-water interface (water immediately above the sediments) were also measured. The water at the mud-water interface in deeper areas (greater than or equal to 9 m) showed almost anoxic conditions. The values of Eh, pH, NO3-N, available P, Mn, Cu, Zn and Co in the sediments showed a negative relationship with water depth and a positive relationship with dissolved oxygen at the interface. The other variables of the sediment were positively related to water depth and negatively related to dissolved oxygen at the interface. As the surface sediments in the hypolimnion were under the influence of reducing and anoxic conditions, a considerable quantity of nutrients might have been released from the sediment to the overlying water. (Author's abstract)
W84-04618

COMPARISON OF SEASONAL AND DIURNAL PATTERNS OF SOME PHYSICO-CHEMICAL PARAMETERS OF THE OPEN AND CLOSED PARTS OF LOKTAK LAKE, MANIPUR, INDIA,
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
For primary bibliographic entry see Field 5C.
W84-04658

DEVELOPMENT AND APPLICATION OF 'U.S.E.D.': A HYDROCLIMATE LAKE STRATIFICATION MODEL,
Salford Univ. (England). Dept. of Mathematics.
B. Henderson-Sellers.
Ecological Modelling, Vol. 21, No. 4, p 233-246, March, 1984. 4 Fig, 3 Tab, 42 Ref.

Descriptors: *Hydroclimate lake stratification model, *University of Salford eddy diffusion model, *Model studies, Hydrologic models, Thermal stratification, Thermocline, Hydroclimatology.

Two model types are currently in use to model the thermal stratification cycle in lakes and reservoirs: the eddy diffusion and the mixed layer (or integral energy) approaches. Here the former is analyzed and developments are proposed to remove the empiricisms previously implicit in these models. These discussions permit the reformulation of KHo independently of current shear, together with an expression for Ri. The deduced formulae are in good agreement with observations. The newly formulated model (the University of Salford eddy diffusion model, U.S.E.D.) is subsequently used in simulations of lakes and reservoirs at different lati-

tudes which are found to be in good agreement with observations without requiring inter-site calibration. (Author's abstract)
W84-04672

MODELLING OF MATTER CYCLE IN A MESOTROPHIC BOG ECOSYSTEM I. LINEAR ANALYSIS OF CARBON ENVIRONS,
Centre of International Projects, Moscow (USSR).
D. O. Logofet, and G. A. Alexandrov.
Ecological Modelling, Vol 21, No. 4, p 247-258, March, 1984. 1 Fig, 6 Ref.

Descriptors: *Organic matter, *Mesotrophic bog, *Linear analysis, *Carbon environs, *Model studies, Plants, Fungi, Bacteria, Litter, Animals, Cycling nutrients, Nutrient removal, Ecosystems.

By means of environ analysis the four-compartment model of matter cycle through the ecosystem of a mesotrophic bog is investigated. The aggregated compartments are: plants, animals, fungi combined with bacteria, and litter. The model is based on data obtained by observations and estimations made on the experimental area of 'Tajozhny Log' located in the southern taiga sub-zone. Environ analysis enables one to set up, in the quantitative form, certain conclusions on the relative importance of individual system components and diverse processes in the matter cycle, as well as to obtain a number of quantitative characteristics of the turnover. The whole quantity of assimilated organic matter is spent for respiration by plants (62%) and by fungi and bacteria (26%). The most part (approximately 70%) of organic matter introduced from the external environment is spent as a result of fungal and bacterial respiration. About 82% of organic matter which flows out of the litter into other compartments will return back to the litter. The organic matter of plants is expected to reside 17 years in the system before leaving it. Assimilated substances reside about 26 years in the system after assimilation. Environ analysis is discussed as a preliminary stage in developing more complex, dynamic models of the matter cycle. (Murphy-IVI)
W84-04673

MODELLING OF MATTER CYCLE IN A MESOTROPHIC BOG ECOSYSTEM, II. DYNAMIC MODEL AND ECOLOGICAL SUCCESSION,
Centre of International Projects, Moscow (USSR).
D. O. Logofet, and G. A. Alexandrov.
Ecological Modelling, Vol. 21, No. 4, p 259-276, March, 1984. 10 Fig, 12 Ref.

Descriptors: *Organic matter, *Mesotrophic bog, *Model studies, *Dynamic models, *Succession, *Ecology, Ergodic hypothesis, Ecosystems, Comparison studies, Performance evaluation.

Based upon the results of static environ analysis of the organic matter cycle through the ecosystem, a number of dynamic models are developed, in this second part, for the matter and nitrogen cycles. Probable outcomes of ecological succession are obtained within the framework of the dynamic model without using the ergodic hypothesis that is implicitly adopted in ecological studies. The probable versions of ecosystem succession under an invariable hydrological regime are, depending on the level of nitrogen nutrition, transition into the forest stage or the conservation of a transitional mesotrophic stage. The transition into a raised (oligotrophic) bog stage is hardly likely, while the transition into a eutrophic-swamp stage is quite impossible. The dynamics of both stocks in the ecosystem components and flows among them can be observed within the model in order to compare some turnover characteristics of the succession series with those of the ecological one. With this model one can observe both the dynamics of stocks in the biocenosis components and the dynamics of the intracenosis flows among them. Given the dynamics of the flows, one can calculate a dynamics of the environs by applying the (static) environ analysis on each time moment from a proper sequence of moments. (Murphy-IVI)
W84-04674

LABORATORY EVALUATION OF KINETIC PARAMETERS FOR LAKE SEDIMENT DENITRIFICATION MODELS,
Utah Water Research Lab., Logan.
J. J. Messer, and P. L. Brezonik.
Ecological Modelling, Vol. 21, No. 4, p 277-286, March, 1984. 2 Fig, 1 Tab, 16 Ref.

Descriptors: *Performance evaluation, *Kinetics, *Lake sediments, *Denitrification, *Model studies, Michaelis-Menten nitrate dependence, Arrhenius temperautre dependence, Mathematical equations, Hydrologic models, Nitrogen cycle, Lake Okeechobee, Florida.

Laboratory experiments using the acetylene blockage technique showed that denitrification rates in sediments from Lake Okeechobee, Florida, are described by Michaelis-Menten nitrate dependence and Arrhenius temperature dependence (Eact = 15.5 kcal), but do not appear to be affected by seasonal differences in the supply of carbon substrates in this eutrophic lake. Peak nitrate concentrations in the sediments are in the range of the half-saturation constant, and thus, for a given temperature, kd varies by a factor of approximately two over the typical range of nitrate concentrations. Most diagenetic sediment denitrification models employ a single-valued rate constant kd, to describe nitrate dependence. However, the use of a constant kd for eutrophic lake sediments may result in a significantly erroneous estimate of annual denitrification loss. (Author's abstract)
W84-04675

MATHEMATICAL MODELLING OF A FISH POND ECOSYSTEM,
Akademiya Nauk SSSR, Moscow. Vychislitelnyi Tsentr.
Yu. M. Svirezhev, V. P. Krysanova, and A. A. Voinov.
Ecological Modelling, Vol. 21, No. 4, p 315-337, March, 1984. 12 Fig, 4 Tab, 15 Ref.

Descriptors: *Mathematical models, *Fish ponds, Fertilizers, Nutrients, Climates, Carp, Silver carp, Bighead, Aeration, Ecosystems.

A mathematical model is constructed for a fish breeding pond for carp, silver carp and bighead. The model is a system of ordinary differential equations describing the material transformations in the ecosystem. It allows a choice of optimal regimes of the aeration, feeding and fertilization of a pond for different climatic conditions in order to maximize the yield. As a result of simulations, the dynamics of the variables that adequately reflect the real picture of the development of the ecosystem for one season are derived. The phytoplankton growth is limited by nutrients (mostly phosphorus). Fish consume a lot of zooplankton, but its concentration may increase at the beginning of the season. A lot of benthos is consumed by carp. Carp begins to gain weight at the very beginning of the season, whereas bighead and silver carp begin to grow only in July, as their growth is to a greater extent limited by temperature. Right after their application, fertilizers are quickly consumed, and the phytoplankton concentration increases. The oxygen control unit is so designed that the oxygen content never drops below 3 mg/l. The artificial aeration is increased when this threshold is passed. The amount of detritus has increased by the middle of the season, and then begins to diminish due to its uptake by bighead and silver carp. (Baker-IVI)
W84-04677

LIMNOLOGICAL STUDIES OF THE LAKES AND STREAMS OF THE UPPER QU'APPELLE RIVER SYSTEM, SASKATCHEWAN, CANADA, II. PHYTOPLANKTON PRIMARY PRODUCTION AND ALGAL SPECIES ABUNDANCE AND OCCURRENCE,
Saskatchewan Univ., Saskatoon. Dept. of Biology.
U. T. Hammer.
Hydrobiologia, Vol. 99, No. 2, p 125-144, March, 1983. 11 Fig, 2 Tab, 37 Ref. National Research Council grant A1412.

Descriptors: *Limnology, *Qu'Appelle River, *Saskatchewan, *Canada, Primary production, Phytoplankton, Biomass, Eutrophic lakes, Species composition, Species diversity, Population density.

High phytoplankton productivity characterizes the eutrophic lakes of the upper Qu'Appelle River system. Annual primary production varied from 187 to 561 g C/sq m while daily areal production varied from 290 to 8575 mg C/sq m. The Amax range was 164 to 315 mg C/cu m/h with the highest rates usually occurring in August or September. Amax values on any given day normally occurred in the top 0.5 m. Blue-green algae (Aphanizomenon flos-aquae, Microcystic aeruginosa, Oscillatoria prolifica) dominated the phytoplankton communities during the summer and fall. Diatoms (Asterionella formosa, Fragilaria capucina, Stephanodiscus niagarae) often dominated the spring communities but sometimes persisted as dominants through the summer. Fragilaria on occasion was present at very high concentrations in the late fall. Ceratium hirundinalle was sometimes dominant but was usually an important part of the biomass. Green algae, although always present, rarely formed an important part of the biomass with Pediastrum duplex the only exception. A species list is appended. (Author's abstract)
W84-04678

DIATOMS OF SURFACE SEDIMENTS OF UTAH LAKE, UTAH, U.S.A.,
Brigham Young Univ., Provo (Utah). Dept. of Botany and Range Science.
J. A. Grimes, and S. R. Rushforth.
Hydrobiologia, Vol. 99, No. 3, p 161-174, March, 1983. 4 Fig, 2 Tab, 44 Ref.

Descriptors: *Lake sediments, *Diatoms, *Utah Lake, *Utah, Sediments, Distribution, Salinity, Nutrients, Bays.

Diatoms were examined in 57 surface sediment samples from Utah Lake. Three hundred and fifteen taxa in 43 genera were identified and quantified. Statistical analyses of the data showed that distinct geographical subregions of the lake could be delineated according to population patterns of the bottom sediment diatoms. Utah Lake is shallow and continuously mixed by wind and water currents. The diatom flora in the sediments of the lake is dominated throughout by centric species, with Cyclotella meneghiniana, Melosira granulata, Melosira granulata var. angustissima and Stephanodiscus hantzschii being the most abundant. The diatom assemblages of Provo Bay and the inner regions of Goshen Bay are unlike those of the main body of Utah Lake. The diatom assemblages of both these areas are unlike each other. Provo Bay seems to be important to Utah Lake by acting as a natural processing area for the high organic load introduced there. Goshen Bay is more saline than Provo Bay and the rest of the lake and lacks most of the cultural perturbations as well. (Baker-IVI)
W84-04679

DECAY RATES AND NITROGEN DYNAMICS OF DECOMPOSING WATERCRESS (NASTURTRIUM OFFICINALE R. BR.),
Department of Scientific and Industrial Research, Taupo (New Zealand). Ecology Div.
C. Howard-Williams, S. Pickmere, and J. Davies.
Hydrobiologia, Vol. 99, No. 3, p 207-214, March, 1983. 5 Fig, 2 Tab, 25 Ref.

Descriptors: *Nitrogen cycle, *Watercress, *Decomposition, Stream ecology, Nitrification, Nitrogen, Ammonification.

Watercress is common along streams draining fertilized pastures in the volcanic plateau of New Zealand's North Island. Its ability to grow well in these areas probably reflects relatively high levels of nitrate and phosphate in such streams, as the plant grows fast and therefore has a high nutrient demand. The decomposition of watercress in the laboratory at 10 degrees and 20 degrees C, and in the field was examined. Rates varied from 0.058 g/g/day in the laboratory to 0.115 g/g/day in the field. There was a rapid generation of particles of size < 500 microm. It is thought that washout of these from the litterbags in the field accounted for

high field decomposition rate. Formation of dissolved nitrogen compounds during decomposition followed a time series from NH4(+) to NO2 (-) to NO3 (-) with dissolved organic nitrogen accumulating at the end of decomposition. Ammonification rates were 480 and 657 g (NH4)-N/g (dry wt)/day and nitrification rates on the decomposing tissue were 640 and 571 microg (NO3)-N/g (dry wt)/day at 10 degrees and 20 degrees C respectively. Fifty-six per cent of the initial plant N was regenerated as NO 3- N, 21% as DON and 25% remained as refractory particulate N. (Murphy-IVI)
W84-04681

ZOOPLANKTON SAMPLING STRATEGIES FOR ENVIRONMENTAL STUDIES,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
M. S. Evans, and D. W. Sells.
Hydrobiologia, Vol. 99, No. 3, p 215-223, March, 1983. 3 Fig, 5 Tab, 17 Ref.

Descriptors: *Zooplankton, *Species diversity, Species, Composition, Spatial distribution, Population dynamics, Populations, Lake Michigan.

This study characterizes sources of variation in total zooplankton abundance estimates at seven stations within the 5-10 m depth contour of southeastern Lake Michigan which were sampled monthly, April through October, for the 1975 to 1979 period. Month, year, and station were statistically significant factors affecting abundance estimates as were all interactions. Month was the largest source of variance either as a main effect or interaction. Smallest coefficients of variation were associated with subsampling (mean 6.1%) and replicate sampling (mean 15.1%). The between-station coefficient of variation averaged 39.0% and tended to be highest during the summer. For a given station and month, the between-year coefficient of variation averaged 73.4% while the between-month coefficient of variation for a single station in a given year averaged 95.1%. A table shows the estimated number of replications necessary to detect a true difference in two population means as a function of coefficient of variation. Environmental studies designed to detect spatial alterations should conduct such analyses on a cruise-by-cruise basis. Cruises should consist of a large number of stations and be conducted at least once during each season. Studies designed to detect temporal alterations require more frequent sampling because of the greater variability associated with temporal data sets. Because spatial variability adds little to the overall variability of such data sets, only a few representative stations need be sampled during each cruise. (Author's abstract)
W84-04682

ALGAL BIOASSAYS AND ALGAL GROWTH CONTROLLING FACTORS IN EUTROPHIC SHALLOW LAKES,
Station Biologique de la Tour du Valat, Arles (France).
H. L. Golterman.
Hydrobiologia, Vol. 100, p 59-64, April, 1983. 1 Fig, 3 Tab, 14 Ref.

Descriptors: *Bioassays, *Algal growth, *Eutrophic lakes, Nitrogen, Phosphate, Lake Tjeukemeer.

Bioassays with water of eutrophic Lake Tjeukemeer were carried out in the laboratory, and, in the lake itself, by placing plexiglass tubes firmly in the mud. In the laboratory nitrogen had a strong growth-promoting effect on the concentrations of chlorophyll a, N-cell and COD-cell. In the bioassays in situ nitrogen increased the concentration of chlorophyll a, but not those of cellular N and cellular COD. It is argued that chlorophyll a is not a good indicator for algal growth in bioassays and that the extrapolation of laboratory experiments where nitrogen limited algal growth - to the field situation - where light limited algal growth - often leads to erroneous results, especially in shallow eutrophic lakes. The main reason is probably that in bioassays in the laboratory the nutrient supply - both from external loading and from sediments is often different and that processes like denitrification occur in the lake, but not in the bioassays. (Author's abstract)
W84-04684

GROUNDWATER AND STREAM ECOLOGY,
Waterloo Univ. (Ontario).
H. B. N. Hynes.
Hydrobiologia, Vol. 100, p 93-99, August, 1983. 62 Ref.

Descriptors: *Ecosystems, *Groundwater, *Streams, Hyporheos, Organic matter, Absorption, Stream beds, Surface-groundwater relations, Interflow.

The functioning of running water ecosystems is considered as it applies to a more thorough consideration of the role of groundwater in stream ecology. Groundwater enters stream channels along routes that can be determined by the construction of flow nets. In reasonably porous sediments the lines of flow arrive at right angles to the perimeter of the stream. Thus shallow, possibly younger, groundwater arrives near the bank and deeper groundwater towards the middle. Any water that reaches a stream directly from the unsaturated zone, a phenomenon called interflow, does so also at the stream edge. Many studies of the hyporheal zone are cited, most dealing with physical and chemical conditions to which the hyporheos is exposed. Groundwater serves also as a source of organic matter. There have been but a few studies to data comparing the dissolved organic carbon levels in groundwater near a stream and that which actually enters the stream, and none that compares different vertical levels within the groundwater. Recent studies on the complex layer of slimes on stones, which are doubtless involved in the rapid uptake of organic matter from the water show that it occurs both above and below stones. Possibly therefore biotic complexes of this sort actually within the substratum are involved in the removal and metabolism of organic matter coming in with the groundwater. (Baker-IVI)
W84-04685

PHOSPHORUS LIMITATION IN SOME TROPICAL AFRICAN LAKES,
McGill Univ., Montreal (Quebec). Dept. of Biology.
J. Kalff.
Hydrobiologia, Vol 100, p 101-112, April, 1983. 11 Fig, 1 Tab, 47 Ref.

Descriptors: *Phosphorus, *Tropical regions, *Lakes, *Africa, *Nutrient requirements, Cycling nutrients, Lake Naivasha, Lake Oloidien, Lake Memphremagog, Lake Sonachi, Prediction, Kenya.

Two of three Kenyan lakes studied between November 1979 and October 1980 have very short (PO4)-33 turnover times, indicating a high phosphorus (P) demand throughout the year. The P turnover time in Lakes Oloidien and Sonachi is as rapid as in the most P deficient temperate zone lakes. The third lake, Lake Naivasha, has a lower overall P demand and a wide seasonal range, with lowest demand between November 1979 and February 1980 when a P deficiency was unlikely. On an annual basis the Lake Naivasha status is, however, not statistically different from that recorded during the summer in Lake Memphremagog, a generally P-limited temperate zone lake. Lake Naivasha and Lake Oloidien fit well to the line of best fit for the Dillon-Rigler relationship relating total phosphorus (TP) and chlorophyll a derived in temperate zone lakes. Thus, temperate zone models predicting aspects of lake behavior on the basis of TP may also be applicable dramatically to the fertilization of enclosures with P. However, it does not fit the TP-chla or the total nitrogen-chla plots from the temperature zone. This suggests that, in this saline lake at least, much of the TP is unavailable to the algae, with some of it in a particulate form that is readily extracted with boiling water. The epilimnetic N:P ratios also characterize lakes. Oloidien and Sonachi lakes as highly P deficient and lake Naivasha as more moderately P limited. A single set of measurements in Winam Gulf (Lake Victoria) also showed a rapid P turnover time and thus P limitation, but as in Lake Sonachi much of the TP was in a non-algal particulate form. Occasional measurements in three other hypertrophic and saline lakes suggest them to be primarily light limited on the basis of their very photosynthetic cover. These findings support the hypothesis of a primary P limitation for those lakes not light limited, and contradicts literature suggestions that nitrogen is the primary limiting element in tropical lakes. (Author's abstract)
W84-04686

LIMNOLOGY OF THE RIVER BANDAMA, IVORY COAST (LIMNOLOGIE DU FLEUVE BANDAMA, COTE D'IVOIRE),
Office de la Recherche Scientifique et Technique Outre-Mer, Paris (France).
C. Leveque, C. Dejoux, and A. Iltis.
Hydrobiologia, Vol. 100, p 113-141, April, 1983. 23 Fig, 1 Tab, 85 Ref.

Descriptors: *Limnology, *Bandama River, *Ivory Coast, Hydrology, Chemical properties, Phytoplankton, Epiphytes, Insects, Fish, Shrimp, Ecology, Environmental impact statement, Pesticides, Dam effects, Environmental effects.

In recent years, the Bandama river and its catchment area have been subjected to intense limnological research, in the framework of a program of ecological monitoring of aquatic environment, treated with anti-simulium insecticides (W.H.O. project for Onchocerciasis control in West-Africa). The present contribution summarized the information collected on this tropical river. After a brief description of the basin and its geological setting, climatic and hydrology, results of studies on the water chemistry, biology and ecology of its animal and plant communities (plankton, periphyton, insects, decapod crustaceans, fish) are presented. The human impact on the system (dam-building, use of pesticides) is also discussed. (Author's abstract)
W84-04687

ASPECTS OF THE HISTORY AND EVOLUTION OF ALPINE LAKES IN AUSTRIA,
Vienna Univ. (Austria). Zoologisches Inst.
H. Loffler.
Hydrobiologia, Vol. 100, p 143-152, August, 1983. 4 Fig, 2 Tab, 44 Ref.

Descriptors: *Geological history, *Alpine lakes, *Austria, Eutrophication, Nutrients, Industrial wastes, Meromictic lakes, Water pollution sources, Lake restoration.

The age of lake basins, the onset of meromictic conditions and some consequences of eutrophication and reoligotrophication of Austrian Alpine lakes are presented. Apart from obviously young lake basins formed by fluviatile action, by karstic events, or by landslides, many of the natural Alpine basins are primarily tectonically preformed but utimately shaped by glacial action during the Pleistocene. Along with the retreat of glaciers, landslides and dams produced by tributaries obviously must have resulted in many transitory lakes. The first reports of lake dwellings date from the 16th century when remnants of such settlements were discovered in Lake Constance. Animal remains in sediments of holomictic lakes suggest that the distribution of the limnocytherids depended to some extent on hydrographic conditions during the Late Pleistocene. Austria has about 20 meromictic lakes. Industrial impacts and a wide variety of human influences such as forest clearing, fish stocking and the introduction of exotic species, engineering work and nutrient loading have affected the alpine lakes of Austria. Apart from possible natural eutrophication mainly just after the retreat of glaciers, nutrient loading with its consequences caused by man started in many Alpine lakes about 100 years ago. The monitoring of the Alpine lakes in Austria started after the Second World War, when trophic evolution accelerated to an alarming extent. The restoration technique used in meromictic lakes has contributed to the improvement in oxygen distribution. (Baker-IV)
W84-04688

A REVIEW OF BASIC ECOLOGICAL PROCESSES INTERACTING WITH PRODUCTION AND STANDING-STOCK OF PHYTOPLANKTON IN LAKES AND RESERVOIRS IN BRAZIL,
Universidade Federal de Sao Carlos (Brazil). Lab. of Limnology.
J. G. Tundisi.
Hydrobiologia, Vol. 100, p 223-243, April, 1983. 15 Fig, 7 Tab, 40 Ref.

Descriptors: *Phytoplankton, *Lakes, *Reservoirs, *Productivity, *Cycling nutrients, *Brazil, Stratification, Environmental effects, Water level fluctuations, Limnology.

The interactions of the main forcing functions in shallow lakes and reservoirs in Brazil with the functioning of the phytoplankton community from the point of view of primary production and standing-stock are discussed. Forcing functions were water level fluctuation, destratification and mixing, wind action and precipitation. One of the major factors controlling variations in productivity and nutrient availability, diurnal variations of environmental factors, is also discussed. Its role in microstratification and replenishment of nutrients to the euphotic zone in shallow lakes is stressed. Major processes in reservoirs are related to residence time, 'hydraulic stratification', sediment-water interaction, and cultural eutrophication. Perspectives for future limnological research by a process-orientated approach are given. (Murphy-IVI)
W84-04691

INPUT-OUTPUT BUDGETS AT LANGTJERN, A SMALL ACIDIFIED LAKE IN SOUTHERN NORWAY,
Norsk Inst. for Vannforskning, Oslo.
R. F. Wright.
Hydrobiologia, Vol. 101, No. 1/2, p 1-12, April, 1983. 6 Fig, 6 Tab, 10 Ref.

Descriptors: *Input-output analysis, *Langtjern Lake, *Acidic lakes, *Norway, Acidic water, Chemical composition, Hydrologic budget, Hydrogen ion concentration, Sulfate, Influent water.

Precipitation and streamwater volume and chemical composition have been measured since 1974 at Langtjern, a small, acid (pH 4.6-4.8) lake on granitic-gneissic bedrock in coniferous forest located ca. 100 km north of Oslo, Norway. The area receives acid precipitation (weighted average pH 4.28). The 7-year input-output budgets for major ions at two terrestrial subcatchments indicate that for Na, K, SO4 and Cl outputs approximately equal inputs, for H+, NH4 and NO3 outputs are much less than inputs, and for Ca, Mg and Al outputs greatly exceed inputs. The sulfate budgets (which include estimated dry deposit) indicate that the terrestrial catchment retains about 20% of the incoming sulfate, perhaps due to absorption in the soil, plant uptake, reduction and storage in peaty areas or reduction and release of H2S to the atmosphere. The budgets for Langtjern lake itself indicate that for most components output equals inputs to within 10%, i.e. these compounds simply pass through the lake. For H+, and possibly NH4 and NO3, inputs exceed outputs. Because gaseous phases are not measured the N budgets are uncertain. A mechanism that leads to 'retention' of both H+ and SOP4 is sulfate reduction and incorporation of sulfides in the lake sediments. Such has been documented in the experimentally-acidified Lake 223, Experimental Lakes Area, Ontario, Canada. Although there is no evidence suggesting the development of anoxic bottom waters at Langtjern, such reduction might occur at the water-sediment interface and in the sediments. The budgets for the pollutant components H+ and SO4 at Langtjern differ substantially from those at the relatively unaffected Lake 239, in the Experimental Lakes Area. (Author's abstract)
W84-04695

SELENIUM AS A GROWTH FACTOR FOR PLANKTON ALGAE IN LABORATORY EXPERIMENTS AND IN SOME SWEDISH LAKES,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
K. Lindstrom.
Hydrobiologia, Vol. 101, No. 1/2, p 35-48, April, 1983. 6 Fig, 4 Tab, 47 Ref.

Descriptors: *Selenium, *Growth media, *Plankton algae, *Sweden, Peridinium, Stephanodiscus, Dinoflagellate, Diatom, Green algae, Calciferous lakes, Acidic lakes, Humic lakes, Bioassays, Bioavailability, Hydrogen ion concentration, Phytoplankton.

The growth requirements of inorganic and organic selenium (Se) for the dinoflagellate Peridinium cinctum fa. westii and the diatom Stephanodiscus hantzschii var. pusillus and eight species of green algae are demonstrated. A new mineral culture medium for P. cinctum is presented. Using P. cinctum as a test alga, bioassays were carried out on waters from a calciferous lake and from some acidified, fertilized, lime-enriched or humic lakes for determination of their contents of bioavailable forms of Se (bioactive Se). Some of the results were related to Tot-Se and selenite-Se, measured chemically, to pH and the occurrence of ambient phytoplankton. In calcium-rich Lake Erken (pH approximately 8) blooms and decline of algae coincided with decreases (from > 70 to approximately 20 ng Se/l) and increased (up to > 80 ng/l) of bioactive Se, indicating uptake and release of inorganic or organic forms of Se. Acidified lakes (pH < 5) generally demonstrated much lower concentrations of bioactive Se (< 20 ng/l) than neutral, fertilized, lime-enriched, slightly acidic or humic lakes (>20 ng/l). The correlation between pH and bioactive Se was positive (r approximately 0.92; n = 7). The ecological importance of Se is suggested for some common species of phytoplankton. (Author's abstract)
W84-04699

BACTERIOPLANKTON IN THE ACIDIFIED LAKE GARDSJON,
Swedish Water and Air Pollution Research Lab., Goeteborg.
For primary bibliographic entry see Field 5C.
W84-04701

RESPIRATION OF PLANKTON IN TWO SMALL, POLYHUMIC LAKES,
Helsinki Univ., Lammi (Finland). Lammi Biological Station.
K. Salonen, K. Kononen, and L. Arvola.
Hydrobiologia, Vol. 101, No. 1/2, 65-70, April, 1983. 4 Fig, 8 Ref.

Descriptors: *Respiration, *Plankton, *Polyhumic lakes, Forest hydrology, Decomposition, Mineralization, Oligotrophic lakes, Energy.

The respiration of plankton of two polyhumic lakes was measured as production of carbon dioxide dark bottles. The method proved to be enough sensitive for use in oligotrophic lakes with low alkalinity. The respiration of plankton followed broadly changes in temperature. However, the primary production of phytoplankton was probably the main factor governing the season pattern of respiration. During summer the respiration of plankton was more than three times higher than the primary production of phytoplankton. This suggests that allochthonous humic substances are an important source of carbon and energy for organisms of polyhumic lakes. (Author's abstract)
W84-04702

SEASONAL DEVELOPMENT OF BACTERIOPLANKTON IN TWO FOREST LAKES IN CENTRAL SWEDEN,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
J. A. Johansson.
Hydrobiologia, Vol. 101, No. 1/2, p 71-88, April, 1983. 9 Fig, 8 Tab, 51 Ref.

Descriptors: *Seasonal variation, *Bacterioplankton, *Forest lakes, *Sweden, Bacteria, Productivity, Biomass, Growth rates, Energy.

Bacteria were counted with acridine orange epifluorescence technique in two humic lakes during 3 years. Less than 1% of the cells were found attached to detritus aggregates. 73% of the total number of 48% of the total volume were smaller than 1 micro m. The mean cell volume ranged from 0.10 to 0.35 micro cu m with the highest cell volumes occurring during early summer contemporarily with the growth of the bacterial biomass and probably indicating favourable growth conditions. The mean density of bacteria in oligotrophic brown-water lakes is higher than in oligotrophic clear-water lakes. The development of bacterial biomass showed a regular and seasonally dependent pattern with maxima during early summer and autumn. The importance of different factors for the regulation of bacterial biomass is discussed. Three different approaches were used to estimate bacterial production. These resulted in an average production rate of 15-60 micro g C/l/d during the growing season. It was concluded that allochthonous sources comprised a significant part of the energy supply to the bacteria in the two humic lakes. (Author's abstract)
W84-04703

RELATIONS BETWEEN PRODUCTION AND BIOMASS OF PHYTOPLANKTON IN FOUR SWEDISH LAKES OF DIFFERENT TROPHIC STATUS AND HUMIC CONTENT,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
U. Heyman.
Hydrobiologia, Vol. 101, No. 1/2, p 89-104, April, 1983. 3 Fig, 6 Tab, 27 Ref.

Descriptors: *Productivity, *Biomass, *Phytoplankton, *Sweden, *Lakes, *Trophic level, Growth rates, Growth equation.

Production and biomass values from phytoplankton populations in four different Swedish lakes were analyzed. The production in all lakes was directly proportional to biomass during homothermal periods. When the lakes were stratified there was a strong negative relation between specific growth rate and biomass. The data fitted to a logistic density dependent growth equation of the form: dB/dt = micro sub m B(1-B/K) where B is the biomass, micro sub m the maximum specific growth rate and K the carrying capacity. The equation was used to derive the parameters micro/micro sub m and carrying capacity (the maximum possible biomass). These parameters were then discussed in relation to light climate, phosphorus concentration and humic content. (Author's abstract)
W84-04704

PRIMARY PRODUCTION AND PHYTOPLANKTON IN TWO SMALL, POLYHUMIC FOREST LAKES IN SOUTHERN FINLAND,
Helsinki Univ., Lammi (Finland). Lammi Biological Station.
L. Arvola.
Hydrobiologia, Vol. 101, No. 1/2, p 105-110, April, 1983. 5 Fig, 1 Tab, 26 Ref.

Descriptors: *Phytoplankton, *Primary productivity, *Lakes, *Finland, Polyhumic lakes, Ecosystems, Forest hydrology, Chlamydomonas, Mallomonas, Chlorophyta.

Primary production and phytoplankton in polyhumic lakes showed a very distinct seasonal succession. A vigorous spring maximum produced by Chlamydomonas green algae at the beginning of the growing season and two summer maxima composed mainly of Mallomonas caudata Iwanoff were typical. The annual primary production was about 6 g org C/sq m in both lakes. The mean epilimnetic biomass was 1.1 in the first and 2.2 g/sq m in the second lake. The maximum phytoplankton biomass, 14 g/sq m was observed during the vernal peak in May. The growing season of phytoplankton in the lakes under study began before the lakes were ice-free because light, which is the minimum factor during winter, could penetrate the ice as soon as snow melted. After the spring maximum, dissolved inorganic nutrient concentrations were very low, and in June Uroglena and Dinobryon

species were the most common in phytoplankton communities. The summer maximum began to develop at the beginning of July, and was composed mainly of Mallomonas caudata in both lakes. During the period of growth various factors control phytoplankton succession and primary production in the lakes studied. Light, nutrients, temperature and flushing seem to be the main factors which affect phytoplankton community and productivity. (Baker-IVI)
W84-04705

ZOOPLANKTIC INDICATORS OF TROPHY AND THEIR FOOD,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
B. Pejler.
Hydrobiologia, Vol. 101, No. 1/2, p 111-114, April, 1983. 1 Tab, 47 Ref.

Descriptors: *Oligotrophic lakes, *Zooplankton, Trophic level, Eutrophication, Sweden, Subarctic zones, Bioindicators, Bacteria, Rotifers.

An analysis was performed concerning the food of oligotrophic as well as eutrophic indicators in order to characterize the specific food requirements of zooplankters in oligotrophic forest lakes. In connection with an increasing trophic degree specialists on small-particle feeding are favored and macrofiltrators disfavored. Consequently, a successively larger fraction of the food will consist of bacteria. Survivors in hypertrophic lakes thus mostly consist of high-efficiency bacteria feeders and of raptorial forms. In the extremely poor, ultraoligotrophic lakes, the number of steps of the ecological pyramid should be relatively small, and all zooplankters could be conceived to be herbivorous. In the rotifer community only suspension feeders were found in all investigated arctic lakes of northern Sweden. Most subarctic lakes contained two or more such species and one case contained five. (Baker-IVI)
W84-04706

GROWTH AND FEEDING OF FREDERICELLA SULTANA (BRYOZOA) IN THE OUTLET OF A HUMIC ACID LAKE,
Bergen Univ. (Norway). Zoological Museum.
G. G. Raddum, and T. M. Johnsen.
Hydrobiologia, Vol. 101, No. 1/2, p 115-120, April, 1983. 3 Fig, 5 Tab, 12 Ref.

Descriptors: *Humic acids, *Bryozoa, *Fredericella, *Lake Ulsetstemma, *Norway, Growth, Feeding, Eutrophication, Algae, Nutrients, Phytoplankton, Hydrogen ion concentration, Biomass.

In the period July 1970-October 1972 sampling and observations of F. sultana were carried out every second week during the growing season and once a month during winter. Ionic content and pH found in Lake Ulsetstemma were typical for lakes situated in forest areas in Norway. The water was humic with color ranging betwen 25 and 143 mg Pt/l, pH between 5.0-6.0, conductivity between 25-60 microS/cm and Ca in the range of 0.8-2.1 mg/l. The content of particulate organic matter was usually less than 5 mg/l but values up to 11 mg/l were measured. F. sultana species was able to stay in humic water with pH down to 5.0. In absence of predation F. sultana can build up great biomass utilizing the drift of nutrition from the water body. During algal blooms and suitable temperature the animals have rapid growth rate feeding on particle sizes from the smallest up to about 240 micro m in length. The width of the particles, however, cannot be greater than the mouth opening. As F. sultana has a very poor digestion the animal has to maintain a high turnover of nutrition particles. Colonies in rapid growth may therefore play an important role regarding breakdown and recycling of nutrition in the freshwater ecosystem as well as structuring the phytoplankton community by the selective feeding observed. (Baker-IVI)
W84-04707

THE FOOD PREFERENCE OF VENDACE (COREGONUS ALBULA) IN SOUTH SWEDISH FOREST LAKES INCLUDING THE PREDATION EFFECT ON ZOOPLANKTON POPULATIONS,
Lund Univ. (Sweden). Limnological Inst.
S. F. Hamrin.
Hydrobiologia, Vol. 101, No. 1/2, p 121-128, April, 1983. 5 Fig, 4 Tab, 30 Ref.

Descriptors: *Oligotrophic lakes, *Zooplankton, *Lake Bolmen, *Sweden, *Vendace, Forest lakes, Predation, Fish food, Bacteria, Aquatic animals, Fish, Crustaceans.

Lake Bolmen is an oligotrophic lake situated in the southwestern part of Sweden. The lake has three basins of which the biggest, used for this study, has a maximum depth of 37m. Thermal stratification takes place at depths between 10 and 20 m during summer. The fish fauna is dominated by vendace and perch. Vendace is the most common fish species in Lake Bolmen. The population, which is strongly dominated by age class 0+, exhibits cyclic population oscillations with a strong year class every second year. The pelagic crustacean fauna in vendace lakes is dominated by small species like Bosmina coregoni, Daphnia cristata, Thermocyclops and Mesocyclops sp. and Eudiaptomus sp. During periods of maximum vendace abundance only Bosmina coregoi is left of the cladocerans, while the abundance of cyclopoid copepods increases. (Baker-IVI)
W84-04708

NUTRIENT AND OXYGEN REDISTRIBUTION DURING DESTRATIFICATION IN THE ELEFSIS BAY, AN ANOXIC BASIN,
Institute of Oceanographic and Fisheries Research, Athens (Greece).
N. Friligos.
Hydrobiologia, Vol. 101, No. 3, p 223-230, May, 1983. 4 Fig, 1 Tab, 18 Ref.

Descriptors: *Nutrients, *Oxygen balance, *Destratification, *Elefsis bay, Mixing, Oxygen, Phosphate, Silicate, Ammonia, Cycling nutrients.

Destratification in Elefsis Bay due to winter cooling, heavy water formation and mechanical mixing produces homogenous water column that is moderately stratified during the summer as a result of surface heating and reduced mechanical mixing. In the Elefsis Bay, this destratification redistributes ammonia, phosphate and silicate regenerated by the organic matter as well as oxygen from the surface. This redistribution has significant implications for nutrient cycles and organism distribution in the Bay. Reasons for the increase of the phosphate concentrations through release of P from the sediments and the conversion of nitrate to nitrogen gas in oxygen-deficient water have been confirmed. The relation between the accumulation of phosphate, silicate and ammonia are discussed. (Author's abstract)
W84-04713

AN IMPROVED ENVIRONMENTAL INDEX BASED ON THE RELATIVE ABUNDANCE OF OLIGOCHAETE SPECIES,
Institute of Freshwater Research, Drottningholm (Sweden).
G. Milbrink.
Hydrobiologia, Vol. 102, No. 2, p 89-97, June, 1983. 2 Fig, 3 Tab, 16 Ref.

Descriptors: *Environmental index, *Oligochaetes, Species diversity, Equilibrium state, Shannon-Weaver index, Simpson's index, Comparison studies, Population density.

Howmiller and Scott presented an 'Environmental Index' based on thorough knowledge of the ecological demands of species of freshwater oligochaetes frequently found in North American waters. These authors emphasized the fact that common diversity measures do not utilize information about the ecological attributes of the constituent species but rather about community structure. A modification of the 'Environmental Index' is here presented with the aim of increasing its sensitivity in Europe and possibly also in North America. Four ecological groups are here preferred to the original three, and the ecological valence of the 'key-species' Tubifex is discussed at some length. Whereas most environmental and diversity indices remain little affected by changes in the total abundance of oligochaetes, the modified index is sensitive to such changes. Comparisons are made with two of the most popular diversity indices applied to specific situations, i.e. the Shannon-Weaver index and Simpson's index. In spite of recommendation in pollution manuals, indices of diversity may be inadequate in correctly characterizing situations of nutrient enrichment of freshwater environments. In the present study it is stressed that low diversity is usually found at both ends of the trophic scale and high diversity, which is supposed to characterize a clean and unstressed environment, is generally obtained in zones of transit between oligotrophic and eutrophic conditions - a likely result of the 'nonequilibrium state' described by Connell (1978) from coral reefs and rain forests in the tropics. (Author's abstract)
W84-04718

FUNGI AND BACTERIA ASSOCIATED WITH PINE (PINUS KESIYA ROYLE) NEEDLES AND TEAK (TECTONA GRANDIS L.) LEAF LITTERS DURING PROCESSING IN A FRESHWATER LAKE,
North-Eastern Hill Univ., Shillong (India). Dept. of Botany.
R. R. Mishra, and B. K. Tiwari.
Hydrobiologia, Vol. 102, No. 2, p 123-129, June, 1983. 3 Fig, 3 Tab, 28 Ref.

Descriptors: *Fungi, *Bacteria, *Pinus, *Tectona, *Freshwater lakes, Litter, Population density, Species composition, Decomposition, Chemical properties, Physical properties, Organic matter.

The process of decomposition is extremely complex and is controlled by a multitude of organisms, by the chemical and physical properties of the litter and by the abiotic environment. Pinus kesiya Royle needles and Tectona grandis L. leaves were exposed in a freshwater lake at three stations and at different depths for a period of 600 days using plastic net bags (1 mm pore size). The fungal and bacterial populations associated with the two litters were estimated at periodic intervals. Rapid initial colonization (up to 100 days) and a lowering of populations after 200-300 days, followed by another peak after 400-500 days were noted. Both fungi and bacteria followed almost similar trends of population variation. Litter at the shallow stations harbored more fungi and bacteria. The species composition of fungi varied with time. The possible role of terrestrial fungi in aquatic habitats is discussed. (Murphy-IVI)
W84-04720

MICROBIOLOGICAL DESCRIPTION OF THE KIEV RESERVOIR IN THE 13TH TO 14TH YEARS OF ITS EXISTENCE,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
L. E. Mikhaylenko, T. V. Golovko, and E. I. Dukhovnaya.
Hydrobiological Journal, Vol. 19, No. 2, 1983. 5 Fig, 4 Tab, 9 Ref.

Descriptors: *Microbiological studies, *Bacteria, *Kiev reservoir, *USSR, Dam effects, Postimpoundment, Reservoirs, Biomass, Nutrients, Plankton, Zooplankton, Productivity.

The Kiev reservoir, impounded in 1965, is located on the upper reaches of the Dnepr, 30 km above Kiev (USSR). Its water has a high color, relatively high concentration of iron (0.200 to 0.320 mg/l), and a low phosphorus content (0.01 to 0.02 mg/l). A multiyear study of the bacterioplankton dynamics in the Kiev reservoir showed a 'flooding effect' in the first three years, with a spurt in bacterial numbers as a result of mineralization of organic matter accumulated in the flooded zone. The microbiology of the reservoir has remained stable since 5 to 6 years after its damming. Bacterioplankton counts are now lower than immediately after damming or before regulation of the river. The bacterial population in the reservoir has stabilized not because of lesser availability of food but be-

cause of regulation by zooplankton, which now consumes more bacteria, as well as because of lower reproduction rate of the bacteria. This reproduction rate has declined to the point that the average generation lifetime is now 60 hr, compared to 24 hr in 1965 to 1967. The reservoir has become mesotrophic. (Moore-IVI)
W84-04722

DISTRIBUTION AND PRODUCTION OF MACROPHYTES IN SMALL LAKES OF CENTRAL KARELIA,
Akademiya Nauk SSSR, Petrozavodsk. Karelskii Filial.
E. A. Klyukina, and K. V. Freyndling.
Hydrobiological Journal, Vol. 19, No. 2, p 27-31, 1983. 4 Tab, 7 Ref.

Descriptors: *Lakes, *Macrophytes, *Karelia, *USSR, Aquatic plants, Littoral zones, Transparency, Plant growth, Acidity, Salinity, Biomass, Primary productivity.

Data are given on the mode and level of macrophyte overgrowth of seven small lakes surrounding the Segozero reservoir in Central Karelia. The macrophyte distribution in various lakes is analyzed as a function of the littoral zone development, water transparency, pH, and salinity. Estimates of annual macrophyte production in the lakes, their energy equivalents, and importance in the organic and mineral balance are presented. The lakes can be divided into two groups based on their plants. In the four lakes where helophytes were dominant, they accounted for most of the plant production. The lowest quantity of organic carbon per sq m (0.6 g) of lake surface is released by dying macrophytes in Sukkozero, and highest (5.1 g) in Lake Torosyarvi. The importance of macrophytes in the balance of organic and inorganic matter in the lakes was estimated on the basis of chemical analysis of the plants and the reserves of phytomass. A definite quantity of various substances is accumulated annually as a result of metabolic activity in the aerial part of macrophytes. A large part of this matter reenters the lakes upon death of these plants. The largest quantity of these substances reenters Syargozero and the smallest reenters Lake Torosyarvi. The area of overgrowth of these lakes depends on their morphology, hydrology, and hydrochemistry. The magnitude of primary production of macrophytes in turn, depends on the plant overgrowth area. Macrophytes are moderately well developed in all these lakes investigated and may promote fish breeding should the small lakes of the Segozero group be used for this purpose in the future. (Baker-IVI)
W84-04723

EUTROPHICATION OF THE MACROPHYTE OVERGROWN LAKES,
Akademiya Nauk SSSR, Moscow. Inst. Geografii.
T. N. Pokrovskaya.
Hydrobiologia, Vol. 19, No. 3, p 12-18, 1983. 6 Fig, 11 Ref.

Descriptors: *Eutrophication, *Macrophytes, *Eutrophic lakes, Phytoplankton, Blooms, Cycling nutrients, Bioassays, Organic matter, Photosynthesis, Bioaccumulation.

The eutrophication of lakes is generally assumed to be ralated with the productive activity of phytoplankton. The quantities and rates of photosynthesis of such plankton are considered to be most important characteristics of the trophicity of a lake, and thus of the level of its eutrophication. However, it is also known that eutrophication is not produce by phytoplankton alone. It is often due to the activity of submerged macrophytes, which not only produce organic matter, but also are important regulators of the nutrient cycles in such lakes. The functioning of macrophyte-overgrown lakes precludes phytoplankton blooms not only under natural conditions but also when the nutrient load is increased by pollution. Only very large nutrient overloads cause complete failure of the system, at which point phytoplankton becomes a major organic-matter producer in the lake. The failure comes on gradually. Its extent can be estimated from the phytocenotic conditions in submerged plants, i.e., their qualitative and quantitative composition, productivity and nutrient availability, as determined by tissue analysis. (Murphy-IVI)
W84-04728

COMPARISON OF FUNCTIONING OF PLANKTONIC COMMUNITIES IN ENCLOSED AND OPEN PARTS OF A RESERVOIR,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
V. I. Shcherbak, A. I. Denisova, G. A. Zhdanova, T. V. Golovko, and V. S. Fedak.
Hydrobiologia, Vol. 19, No. 3, p 19-25, 1983. 7 Fig, 16 Ref.

Descriptors: *Comparison studies, *Functioning, *Plankton communities, Enclosed reservoirs, Open reservoirs, Hydrobiology, Reservoirs, Chemical properties, Phytoplankton, Bacterioplankton, Zooplankton, Population dynamics, Kiev reservoir.

The present objective was to explore the possibility of using closed (isolated) parts of reservoirs for hydrochemical and hydrobiological studies, to investigate the effect of isolation on the functioning of the planktonic communities. The thermal and hydrochemical (O2, O-3, PO4, Fe+2 + Fe+3 concentrations) indices of an enclosed and open part of the Kiev reservoir are compared. The quantitative and qualitative compositions of bacterio-, phyto- and zooplankton were determined, and the phyto- and bacterioplankton production was estimated. Isolation of relatively large areas of a reservoir for a few months has no significant effect on the development of various components of the plankton. This allows for long-term experiments on the structure and functioning of the planktonic communities for the purpose of understanding the effects of factors such as the concentrations of nutrients, fungicides, toxicants, allochtonic and other substances under the conditions with maximum similarity to natural ones. (Murphy-IVI)
W84-04729

ZOOPLANKTON AND FEEDING OF YOUNG FISH IN THE ZONE OF DISCHARGE OF EFFLUENTS FROM THE TRIPOL'YE POWER PLANT,
Tikhookeanskii Nauchno-Issledovatel'skii Inst. Rybnogo Khozyaistava i Okeanograffii, Vladivostok (USSR).
For primary bibliographic entry see Field 5C.
W84-04731

BACTERIA ON VASCULAR AQUATIC PLANTS,
Akademiya Nauk SSSR, Borok. Inst. Biologii Vnutrennykh Vod.
V. M. Kudryavtsev.
Hydrobiologia, Vol. 19, No. 3, p 50-55, 1983. 4 Tab, 12 Ref.

Descriptors: *Bacteria, *Vascular aquatic plants, *Aquatic plants, Population dynamics, Macrophytes, Littoral zone, Rybinsk reservoir, Decomposition, Biomass, Fouling, Cycling nutrients, Assimilative capacity.

Microorganisms that are part of the periphytonic communities are important in biological recycling of matter. The dynamics of development, total number and physiological groups of bacteria were determined in the communities fouling the macrophytes of the southern littoral zone of the Rybinsk reservoir. The total number of bacteria (counted directly) ranged from 3 to 4 million/sq cm. The rate of hetrotrophic carbon dioxide assimilation by the bacteria ranged between 0.03 and 1.61 million mocro g C/sq cm/day. The output of bacterial biomass was in the range of 0.5 to 26.8 micro g C/sq cm per day. The fouling community contains large numbers of bacteria capable of growing on RPA, fungi, Azotobacter, as well as starch- and cellulose-decomposing bacteria. (Murphy-IVI)
W84-04733

FISH FRY IN BEDS OF AERIAL-AQUATIC PLANTS,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
V. L. Dolinskiy.
Hydrobiologia, Vol. 19, No. 3, p 86-91, 1983. 3 Tab, 13 Ref.

Descriptors: *Aquatic plants, *Fish fry, Growth, Fish diets, Biocenosis, Species composition, Population dynamics, Seasonal variaton, Water Mannagrass, Lesser reedmace, Common reed, Dnieper reservoirs.

Seasonal dynamics of fish fry inhabiting the biocenoses of aerial-aquatic plants of the Dnieper reservoirs have been studied by means of a buoyant net. The water-manna-grass, reedmace and reed beds were found to contain 23 species of fry. Reed beds exhibit the greatest species diversity, and water manna-grass beds the lowest diversity. The ichthyofaunas of the manna-grass and reedmace coenoses exhibit the highest commonality of species. Roach, rudd, white bream, Verkhovka, bleak, bitterling occur most often. Data on numbers and biomass are presented for the fry inhabiting the beds. (Author's abstract)
W84-04735

ECOLOGY OF LEMBADION BULLINUM PERTY AND LEMBADION LUCENS MASKELL,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
A. A. Koval'chuk, and I. Ergashboyev.
Hydrobiologia, Vol. 19, No. 3, p 92-95, 1983. 1 Tab, 32 Ref.

Descriptors: *Ecology, *Lembadion, Decomposition, Organic matter, Self-purification, Species diversity, Hydrobiology.

Information on the ecological characteristics of the individual species of freshwater free-swimming Infusoria is needed for a more accurate determination of the indicator potential of the Infusoria, their role in the processes of the production and decomposition of organic matter in water, and also for their culture on a large scale. An ecological description of Lembadion bullinum Perty and Lembadion lucens Maskell, based on data available in literature and obtained by the authors in the Kiev and Nurek reservoirs (which differ in their typological, hydrological and hydrobiological properties) is presented. Both species have an ecological spectrum in terms of production, organic matter decomposition and saprobic index. The main factors influencing the development of the species are similar, yet L. bullinum is more important in self-purification and production of organic substances in the two reservoirs. (Murphy-IVI)
W84-04736

BIOGENIC REGULATION OF IRON AVAILABILITY IN A EUTROPHIC HARDWATER LAKE,
National Water Research Inst., Burlington (Ontario).
T. P. Murphy, K. J. Hall, and I. Yesaki.
The Science of the Total Environment, Vol. 28, p 37-50, June, 1983. 9 Fig, 18 Ref. National Science and Engineering Research Council grant 67-8935.

Descriptors: *Iron, *Eutrophic lakes, *Biogenic regulation, British Columbia, Phytoplankton, Eutrophication, Algal growth, Aphanizomenon, Anabaena, Iron availability.

Iron availability influenced phytoplankton growth in a naturally eutrophic hardwater lake in British Columbia. Early in the summer the algal biomass (< 15 micro g Chl a/L) was low relative to the phosphorus supply (> 250 micro g/L). The Aphanizomenon blooms (80-150 micro g Chl a/L) did not develop until the Anabaena had died and the iron concentration had increased. Prior to the Aphanizomenon blooms, iron or chelator enrichment of bioassays stimulated algal growth. Most of the epilimnetic iron was particulate. The iron binding capacity of the water was weak but low molec-

ular weight iron chelators were metabolized rapidly. The influence of iron on algal growth was related to limited iron availability and not necessarily to low iron concentrations. Some of the algal community structure was probably determined by iron availability. (Author's abstract)
W84-04739

VITAMIN ENRICHMENT OF LAKE PLANKTON: FIELD TESTS OF MICRONUTRIENT LIMITATION,
Ottawa Univ. (Ontario). Dept. of Biology.
D. K. Smith, T. Mousseau, and F. Briand.
Archiv fur Hydrobiologie, Vol. 99, No. 4, p 433-442, March, 1984. 1 Fig, 2 Tab, 40 Ref.

Descriptors: *Vitamins, *Phytoplankton, *Heney Lake, *Quebec, Algal growth, Algae, Lakes, Nutrients, Thiamine, Vitamin B-12, Biomass.

Levels of biotin, B-12, and thiamine, were experimentally increased in twelve enclosures suspended in Heney Lake, Quebec, to test whether ambient vitamin levels are limiting to lake phytoplankton. A total of 78 phytoplankton species were recorded over the course of study, including 32 green algae, 21 diatoms, 16 blue-greens and 9 species belonging to other taxonomic groups. Only four species were significantly affected: the blue-greens Aphanocapsa and Lyngbya contorta, the green Mougeotia and the diatom Synedra delicatissima. All registered a significant reduction in biomass, which followed the addition of thiamine in the case of Aphanocapsa, and of biotin for the others. L. contorta and S. delicatissima were also reduced by the multiple enrichment, which constituted the only response to that treatment. This constitutes the first direct evidence that vitamin levels are sufficient to meet algal requirements in lakes. (Baker-IV)
W84-04752

A VERSATILE COMPUTER-CONTROLLED TRACKING AND SAMPLING SYSTEM FOR USE WITH MODEL LAKES IN TALL TUBES,
Edinburgh Univ. (Scotland). Grant Inst. of Geology.
M. M. Gibbs, F. R. Ohnstad, and C. R. Cunningham.
Archive fur Hydrobiologie, Vol. 99, No. 4, p 489-497, 1984. 5 Fig, 11 Ref.

Descriptors: *Automation, *Model studies, *Lakes, Computers, Monitoring, Simulation, Data acquisition.

The tall-tube experimental system makes it possible to study an organism or physico-chemical feature of a lake under prescribed conditions with the replications and controls that normally cannot be found in a lake. A computer-controlled tracking system for experimental tubes which simulate lake conditions offers considerable advantages over other systems. It is simple to use and can be readily repositioned for use in different tubes when several simultaneous experiments are being run. Because the probe cable is retained in the apparatus body it is kept free from tangling and is less likely to become contaminated. Once programmed for an experiment it will run identical replicate profiles, thus improving the reliability of the final results. The computer which controls the tracking system is available to receive, process and store data during each profile, thus eliminating the need for several chart recorders and the operator time spent decoding their traces. The system can be left to collect data as programmed with minimal supervision unless discrete samples are also required. The data is stored in a form that can be easily manipulated into statistical analyses without introducing data transfer errors. (Moore-IVI)
W84-04755

NANOPLANKTON: CHIEF PRIMARY PRODUCERS IN LAKE NAINITAL,
Kumaun Univ., Naini Tal (India). Dept. of Zoology.
M. C. Pant, and A. P. Sharma.
Current Science, Vol. 52, No. 15, p 739-741, August 5, 1983. 1 Fig, 15 Ref.

Descriptors: *Nanoplankton, *Primary productivity, *India, *Lake Nainital, Plankton, Phytoplankton, Biomass, Algae, Eutrophic lakes.

The contribution of nanoplankton to total phytoplankton biomass production in Lake Nainital was measured. Nanoplankters (10-20 micron size class in particular) which dominatd the phytoplankton community in terms of standing stock were the main producers of organic matter in the lake. The dominance of these organisms in this eutrophic lake is a limnological paradox. Generally these organisms are abundant in nutrient poor wastes where they materially affect the absorption of nutrients and their subsequent transfer to the higher trophic levels. In eutrophic lakes, the phytoplankton succession culminated into a bloom of blue-green algae and nanoplankton becomes a poor component of the system. However, in this study the eutrophic natures of the water body, i.e. the restricted light penetration, high detritus content and community metabolism, appears to be conducive to greater growth and activity of these organisms. (Baker-IVI)
W84-04758

PLANKTONIC COMMUNITIES IN FLORIDA SOFTWATER LAKES OF VARYING PH,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
P. L. Brezonik, T. L. Crisman, and R. L. Schulze.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 41, No. 1, p 46-56, January, 1984. 8 Fig, 3 Tab, 44 Ref. EPA grant 805560.

Descriptors: *Plankton, *Florida, *Softwater lakes, *Hydrogen ion concentration, Chlorophyta, Cyanophyta, Phosphorus, Phytoplankton, Zooplankton, Species diversity, Productivity.

In 20 softwater Florida lakes (pH range 4.7-6.8), phytoplankton diversity was significantly higher in the less acidic lakes; mean numbers of species in two groups (1, pH $<$ 5.3; 2, pH $>$ 5.6), each consisting of 10 lakes, was 10.8 and 16.5, respectively. Blue-green algae were dominant in less acidic lakes, while green algae were the most common group in acidic lakes. Phytoplankton abundance also was lower in acidic lakes, but covariation of phosphorus concentrations with pH confounded interpretation. Trends in zooplankton communities along the pH gradient were less pronounced. More acidic lakes had more species than the less acidic lakes, but three measures of species diversity showed no significant differences between the two groups. Zooplankton abundance was lower in the acidic lakes, but the relationship between abundance and pH showed much scatter. Lake productivity probably affects zooplankton abundance more than pH does in the sample group. No clear trends were observed in relative abundance of major zooplankton groups across the pH gradient. Six acid-tolerant species (including Diaptomus floridanus, Eubosmina tubicen, and Daphnia ambigua) were dominant in all 20 lakes. (Author's abstract)
W84-04759

LAKE MIXING AND ITS RELATIONSHIP TO EPILIMNETIC PHOSPHORUS IN SHAGAWA LAKE, MINNESOTA,
Wisconsin Univ.-Madison. Water Chemistry Lab.
R. E. Stauffer, and D. E. Armstrong.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 41, No. 1, p 57-69, January, 1984. 6 Fig, 6 Tab, 16 Ref. EPA grant R-805281.

Descriptors: *Mixing, *Shagawa Lake, *Minnesota, Epilimnion, Phosphorus, Eddy conductivity, Thermal stratification, Wind, Lake basins, Climate, Density currents.

Using thermometry, the mixing regime was intensively studied in each of the two principal basins of Shagawa Lake. After the thermocline had migrated past the interbasin sill depth (6m), it migrated more rapidly in the larger, windswept western basin that in the smaller, sheltered eastern basin. The metalimnetic eddy conductivities (Kz) were also larger in the west basin, ranging from 0.025 sq cm/s during intervals of low wind energy up to 0.25 sq cm/s during intervals bracketing powerful cold fronts. The bottom temperature increased rapidly in the west basin in response to mixing, reducing total water column stability and inceasing susceptibility to a sudden 'turnover.' Because of these warm bottom temperatures and drainage basin influence, density currents sometimes carry cold water into the benthic zone of the west basin following heavy, cold rains in midsummer. Epilimnetic phosphorus concentrations in Shagawa Lake depend on linkages among weather, basin morphometry, and water column redox. Time series analysis of 8 yr of record reveals the special importance of two factors. First, the anoxic zone below the mixed layer must include an important fraction of the metalimnetic shelf sediments in the western basin (6-10m zone). Second, the mixed layer must migrate downward and directly entrain water overlying the anoxic sediments. Time series analysis excludes the possibility of sediment release of phosphorus within the epilimnetic zone as the principal control on phosphorus in the pelagic mixed layer. For lakes with similar morphometry and climatic setting, and a previous history of sewage inputs, lake mixing complicates the trophic adjustment of the lake to a reduction in external phosphorus loading. (Author's abstract)
W84-04760

ORTHOPHOSPHATE UPTAKE RATE CONSTANTS ARE MEDIATED BY THE 10(3)-10(4) MOLECULAR WEIGHT FRACTION IN SHIELD LAKE WATER,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
P. Brassard, and J. C. Auclair.
Canadian Journal of Fisheries and Aquatic Science, Vol. 41, No. 1, p 166-173, January, 1984. 3 Fig, 2 Tab, 40 Ref, 1 Append.

Descriptors: *Shield lakes, *Orthophosphates, Phytoplankton, Phosphorus radioisotopes, Uptake, Phosphates, Seston, Plant physiology, Chlorophyll, Lakes.

Midsummer chlorophyll concentrations can be predicted from total phosphorus at spring overturn for a number of North American lakes, but attempts to identify all bioavailable phosphorus compounds has proven difficult. Inconsistencies in determining colloidal phosphorus utilization and the discovery that orthophosphate concentration and flux are poor predictors of lake trophic status indicate that other forms of phosphorus compounds, which may not be necessarily labeled over the radioisotopic uptake assay (P-32) period, are assimilated by natural phytoplankton assemblages. Ultrafiltration methodology was used to test the hypothesis that the orthophosphate uptake rate constant can be physiologically varied upon changing the external concentration of selected molecular weight fractions in Shield lake waters. Experiments were carried out with water from lac Tantarie, an acidic and oligotrophic Shield lake located 42 km north of Quebec City. The fraction between molecular weight 1000 and 10000 significantly increased the orthophosphate uptake rate constant when exposed to the natural seston. This suggests that the orthophosphate uptake rate constant is subject to fluctuations depending on the availability of low molecular weight phosphorus metabolites in the external solution. The physiological basis of these observations may be a metabolic coupling between the activity of plasmalemma-bound phosphatases and the transport of PO4(3-) across the cell membrane. (Moore-IVI)
W84-04763

TRANSPORT OF DISSOLVED ORGANIC CARBON, NUTRIENTS, AND TRACE METALS FROM THE WILSON AND BLOSSOM RIVERS TO SMEATON BAY, SOUTHEAST ALASKA,
Alaska Univ., Fairbanks. Inst. of Marine Science.
S. F. Sugai, and D. C. Burrell.
Canadian Journal of Fisheries and Aquatic Science, Vol. 41, No. 1, p 180-190, January, 1984. 7 Fig, 5 Tab, 38 Ref. DOE contract E(45-1)-2229.

Descriptors: *Nutrients, *Organic carbon, *Trace metals, *Wilson river, *Blossom River, *Alaska,

Solute transport, Salmon, Copper, Iron, Manganese, Muskeg, Metals.

Increasing development poses an immediate threat to the salmon fisheries of southeast Alaska. Regional and seasonal differences in chemical input from the Wilson and Blossom rivers, two pristine, major salmon-producing rivers in southeast Alaska, were examined in order to determine possible restraints on productivity and to examine transport mechanisms of potential toxicants. Concentrations of dissolved organic carbon, nutrients, Cu, Fe, and Mn in the rivers were determined at approximately monthly intervals for a period of two years, and used to calculate export rates. Because of extremely high annual precipitation (400-450 cm) and drainage basins restricted by high topographical relief, the concentrations and export rates of nutrients and Cu are low in the rivers for most of the year. The maximum nutrient export from the Wilson-Blossom system appears to be closely tied to the annual salmon cycle. The decomposition of spawned salmon is the most likely explanation for observed nutrient peaks. Iron and Mn export rates from the watersheds are much high than those for Cu, reflecting solubilization of Fe and Mn under reducing conditions that develop in muskeg ponds during drought periods. The association of metals with organics allows transport of Fe and possibly other metals throughout the fjord system, in contrast with the large-scale removel of metals in or near the river's mouth, as has been observed elsewhere. (Moore-IVI)
W84-04764

APPLYING INFORMATION THEORY TO ANAYSIS OF CATCH DYNAMICS OF FISH IN INCIPIENT ECOSYSTEMS,
Akademiya Nauk SSSR, Borok. Inst. Biologii Vnutrennykh Vod.
M. M. Smetanin, A. S. Strel'nikov, and V. G. Tereshchenko.
Journal of Ichthyology, Vol. 23, No. 4, p 1-7, 1983. 3 Fig, 1 Tab, 20 Ref.

Descriptors: *Fish populations, *Population dynamics, Lakes, Reservoirs, Rybinsk Reservoir, Lake Balkhash, Ecosystems, Species diversity.

With the intensification of the anthropogenic effect on many aquatic ecosystems, disruption of the ecological balance is observed, leading to sharp changes in the abundance of fish species. These are usually ecosystems in the process of formation, such as reservoirs, and isolated lakes. The catch dynamics of fish in two incipient ecosystems, Rybinsk Reservoir and Lake Balkhash, are considered. The dynamics of change in the abundance of individual fish species in the formation of ecosystems is distinguished by great diversity. A fuller quantitative analysis of the change in the structure of the ichthyocoenoses of the ecosystems investigated is obtained using information indicators. These indicators make it possible to compare quantitatively the degree of diversity and disorder in catches, both in one body of water in different years and in different bodies of waters in the same years. In general, the degree of nonuniformity of the contribution of individual fish species to the total catch in both ichthyocoenoses in the years examined showed a tendency to increase. The ranges of fluctuations in indicators, the absolute and relative oganization of fish catches both for the one and the other body of water are about the same, indicating that the organization of both systems is about equal, though in individual years it is noticeably greater in Lake Balkhash than in Rybinsk Reservoir. This study shows that in these years the degree of inequality in the contribution of individual species of Lake Balkhash fish to the total catch was greater than in Rybinsk Reservoir. (Baker-IVI)
W84-04766

2I. Water In Plants

VEGETATION PATTERNS RELATED TO ENVIRONMENTAL FACTORS IN A NEGEV DESERT WATERSHED,
Cornell Univ., Ithaca, NY. Section of Ecology and Systematics.
L. Olsvig-Whittaker, M. Shachak, and A. Yair.
Vegetatio, Vol. 54, No. 3, p 153-165, November, 1983. 4 Fig, 3 Tab, 37 Ref.

Descriptors: *Vegetation, *Deserts, *Watersheds, *Negev Desert, *Israel, Plant growth, Spatial distribution, Arid regions, Soil water.

Pattern analysis was effectively used to demonstrate relationships between spatial patterns of vegetation, surface structure, and movements of soil and water in a Negev Desert watershed. Three strip transects, each about 100 contiguous 0.5 x 1 sq m quadrants, were sampled during the spring bloom of March 1981 across four surface structural units of a Negev Desert research watershed at Sede Boqer, Israel. Presence of all vascular plants was recorded. Data were subjected to detrended correspondence analysis, and resulting spatial patterns of species distribution and abundance were compared. Large-scale gradients of vegetation were related to differences in soil moisture availability among the four structural units. Where microscale vegetation patterns were important, these correlated with rock and crevice microtopography. Species richness was influenced by high numbers of therophytes on the dry upper slope of the watershed and their reduced importance on the lower three units. Relationships between vegetational patterns and known ecosystem properties of the watershed are discussed. The pattern analysis approach was developed to describe vegetation and it has been useful as a heuristic method for the detection of correlations upon which future research in this watershed project can be based. (Baker-IVI)
W84-04191

SUMMER WATER RELATIONS OF ABIES LASIOCARPA, PICEA ENGELMANNII, AND PINUS CONTORTA AT HIGHER AND LOWER ELEVATION SITES IN SOUTHEASTERN WYOMING,
Wyoming Univ., Laramie. Dept. of Botany.
G. A. Carter, J. L. Hadley, W. K. Smith, and D. H. Knight.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-159714, Price codes: A03 in paper copy, A01 in microfiche. Completion Report, Wyoming Water Research Center, Laramie, December, 1983. 24 p, 6 Fig, 3 Tab, 9 Ref. Project No. OWRT A-035-WYO (1), Contract/Grant No. 14-34-0001-2154.

Descriptors: *Soil-water-plant relationships, *Stomatal transpiration, Evapotranspiration, Water stress, Plant water potential, Forests, *Spruce, *Pine, *Fir, *Wyoming, Engelmann spruce, Subalpine fir, Lodgepole pine, *Leaf conductance.

Leaf conductances (g sub wv) to water vapor loss were determined from late May through mid-August for Picea engelmannii, Abies lasiocarpa, and Pinus contorta at 2860 m, and for Picea engelmannii and Abies lasiocarpa at 3200 m in the Medicine Bow Mountains of Wyoming. Moist soil conditions persisted throughout the summer. Near- or below-freezing air temperatures in late spring and early summer limited maximum g sub wv in spruce and fir at 3200 m to 0.4 and 0.1 mm/s, respectively. Following onset of consistently non-freezing nights, maximum daily g sub wv in all species at both elevations generally increased over the summer, but low soil temperatures at the higher elevation site appear to be a primary factor limiting maximum g sub wv. Diurnally, spruce g sub wv was generally greater than fir g sub wv, and pine g sub wv was higher than in either spruce or fir from mid-to late-summer. These results will be useful in developing a computer simulation model for water flow through the subalpine spruce-fir forests of Wyoming.
W84-04226

STUDIES OF WATER UPTAKE FROM MULTIPLE SOURCES,
Minnesota Mining and Mfg. Co., St. Paul. Central Research Labs.
L. A. Errede.
Annals of Botany, Vol. 52, No. 6, p 839-847, December, 1983. 6 Fig, 7 Ref.

Descriptors: *Water uptake, *Plant water potential, Selectivity, Potometry, Membranes, Permeability, Root growth, Hydroponics, Chemical properties.

Many potometric methods for measuring water uptake utilize complicated mechanical devices that are expensive, cumbersome and require significant plant perturbation to establish good mechanical contact with the monitoring system. Water uptake in systems consisting of a potted plant and two embedded reservoirs, which had been fitted with microporous bottoms, were monitored daily over test intervals that ranged from 1 to 3 years. When both reservoirs contained aqueous solutions of the same chemical composition, plants took water from the alternate sources without bias, but when one reservoir contained tap water and the other a strong aqueous nutrient solution, an initially fluctuating bias developed. Eventually the system restabilized at an equilibrium state in which total uptake of water (in l/day) to nutrient salt (in g/day) was about 16 to 1 independent of the concentration in the nutrient solution. This equilibrium ratio was altered sharply whenever the plant was damaged severely, or whenever the quality of the water in one of the reservoirs was impaired by addition of a toxicant. The equilibrium state was re-established within 6 months following plant damage, and within a few weeks following elimination of the toxicant. The above results demonstrate that multireservoir systems, which can be assembled easily from inexpensive components, provide a reliable means for studying water uptake by a single plant from two or more independent sources, and that these systems are very sensitive to changes that affect the physiology of the plant. (Murphy-IVI)
W84-04274

EFFECT OF WATER STRESS ON GRAIN GROWTH AND ASSIMILATE PARTITIONING IN TWO CULTIVARS OF WHEAT CONTRASTING IN THEIR YIELD STABILITY IN A DROUGHT-ENVIRONMENT,
Indian Agricultural Research Inst., New Delhi. Water Technology Center.
P. K. Aggarwal, and S. K. Sinha.
Annals of Botony, Vol. 53, No, 3, p 329-340, March, 1984. 6 fig, 3 Tab, 31 Ref.

Descriptors: *Water stress, *Grain growth, *Assimilate partitioning, *Drought, Crop yield, Drought resistance, Wheat.

Grain yield of cereals is governed by the rate and duration of grain-filling which is a post-anthesis phenomenon. Assimilation and partitioning of photosynthate in relation to grain growth are of vital importance. Grain growth pattern and grain weight in relation to its position between and within spikelets showed assimilate limitation to be a factor reducing grain yield in wheat plants grown on stored moisture in the field. Estimation of the relative contribution of pre- and post-anthesis assimilates to grain yield by a C-14 labelling technique indicated that cultivar C 306, known for its stability in yield and drought-tolerance, was characterized by substantial mobilization of pre-anthesis assimilate (P), both in irrigated (24%) and unirrigated (33%) plants. As against this, in Kalyansona, a high yielding cultivar with moderate stress tolerance, the contribution of P to grain yield was only 13 and 22% in irrigated and unirrigated plants, respectively. The mobilization of amino acids, estimated from nitrogen contents at anthesis and maturity, was decreased by water stress and was accompanied by a corresponding increased transport of carbohydrates. (Murphy-IVI)
W84-04275

EFFECT OF MOISTURE STRESS ON WATER UPTAKE AND SEED GERMINATION OF TWO VARIETIES OF WHEAT,

D.A.V. Coll., Muzaffarnagar (India). Dept. of Botany.
K. P. Singh.
Acta Botonica Indica, Vol. 11, p 43-48, 1983. 1 Fig, 2 Tab, 11 Ref.

Descriptors: *Water Stress, *Water uptake, *Germination, *Wheat, Water potential, Growth, Root growth.

The germination phase of seeds is considered critical for achieving a successful agricultural crop since indirectly, it determines the crop stand density and consequently, yields especially under arid conditions. The water uptake declined with increasing water stress. In both varieties total amount of water uptake was slightly greater at higher water potentials. There was hardly any significant difference in the initial rate of water uptake among treatments at different water potentials. At all the external water potential treatments the rate of water uptake was greater in the beginning and slowed down with time. The rate and total amount of water uptake was greater in var. HD 1981 than var. UP 319. It was observed that seed germination and seedling growth were depressed with a decreasing external water potential in both varieties. The effect of water stress on seed germination percentage and shoot and root length UP 39 proved to be more resistant to increasing water stress conditions than HD 1981. (Murphy-IVI)
W84-04282

WATER-USE EFFICIENCY IN CROP PRODUCTION,
Florida Univ., Gainesville. Dept. of Agronomy.
T. R. Sinclair, C. B. Tanner, and J. M. Bennett.
BioScience, Vol. 34, No. 1, p 36-40, January, 1984. 31 Ref.

Descriptors: *Water use efficiency, *Crop yield, Transpiration, Leaves, Biomass, Water demand.

The mechanisms that influence water use efficiency in plants are reviewed. The processes regulating leaf gas exchange are studied. Additional processes and relations are assembled to analyze water use efficiency in crop biomass and grain production, then in evapotranspirational water use efficiency expressed on the basis of total water input to the system. This analysis clarifies the important variables and the opportunities available for further improvements in water use efficiencies. Only a few variables were found to be available for manipulating water use efficiency and many of these have already been exploited to a large degree. The five options for improving water use efficiency are: biochemical alterations; alteration of the cropping environment; stomatal physiology; improved harvest index; and increased proportion of transpired water. Crop production is inextricably linked to crop transpiration. To increase crop biomass production, more water must be used in transpiration. (Baker-IVI)
W84-04284

TOWARD UNDERSTANDING SOIL WATER UPTAKE BY PLANT ROOTS,
Oregon State Univ., Corvallis. Dept. of Soil Science.
E. L. McCoy, L. Boersma, M. L. Ungs, and S. Akratanakul.
Soil Science, Vol. 137, No. 2, p 69-77, February, 1984. 9 Fig, 1 Tab, 16 Ref.

Descriptors: *Soil water, *Roots, Root surface matric potential, Plant water potential, Soil physical properties, Soil-water-plant relationships, Chino clay, Pachappa sand, Indio silt loam.

Plant water uptake is examined from a uniformly rooted soil volume by numerically solving the nonlinear diffusion equation for a soil cylinder bounded externally by an insulating surface, located at the half-distance between adjacent roots and internally by the root surface. A sinusoidally varying uptake rate is employed to simulate the diurnal evaporative demand, while the actual water flux across the inner surface is controlled by the root surface matric potential through a stomatal adjustment function. The analysis is conducted for Chino clay, Pachappa sand, and Indio silt loam, using hydraulic parameters determined from piecewise continuous exponential functions of the dependent variable matching data for these soils. The analysis uses root radii of 0.003, 0.005, 0.010, and 0.020 cm and root densities of 0.080, 0.142, 0.318, and 0.650 cm root length per cubic centimeter of soil. The transient matric potential distribution in the soil depends strongly on the precise nature of the hydraulic parameters for each soil: as the soil loses water by transpiration, the value of the bulk soil matric potential decreases monotonically at a rate dependent upon the specific water capacity of the soil. For initial bulk soil potentials of -0.3 bar in the Chino and Indio, and -0.2 bar in the Pachappa, the initial rate of potential decrease with time is greatest in the Chino, followed by the Pachappa and Indio, respectively. The corresponding radial potential distribution around individual roots depend upon the instantaneous value of the soil water diffusivity, which decreases as the soil dries, creating steep potential gradients adjacent to the root, with the largest initial gradients occurring in the Chino clay, followed by equivalent gradients in the Pachappa sand and Indio silt loam. The relative rate of decrease in the bulk soil potential and the drawdown around a root for the three soils, however, changes with time as the soil dries. The drawdown around a root is reduced by increasing root densities, so that at low densities the root surface potential depends more closely upon the diffusivity, whereas at high densities the root surface potential depends more closely upon the specific water capacity. In addition, roots of smaller radii exhibit greater drawdown as the total root surface area decreases and the flux of water at the root surface increases. The simulation of root water uptake using piecewise continuous functional relationships for the diffusivity and specific capacity produces results that form a coherent illustration of plant survival in three diverse soil environments. (Murphy-IVI)
W84-04344

OPTIMUM WATER USE BY STONE FRUIT THROUGH IRRIGATION SCHEDULING,
Michigan State Univ., East Lansing. Dept. of Horticulture.
J. A. Flore, and V. F. Bralts.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84169408, Price codes: A04 in paper copy, A01 in microfiche. Completion Report, September, 1983. 54 p, 22 Fig, 10 Tab, 11 Ref. Project No. OWRT B-060-MICH(1), Contract/Grant No. 14-34-0001-1235.

Descriptors: *Irrigation requirements, *Fruit, Crops, *Trickle irrigation, *Michigan, *Plant growth, Soil moisture, *Irrigation scheduling, Cherry trees, Peach trees, Stone fruit.

Since 1971, trickle irrigation has been installed on an estimated 50,000 acres of tree fruit in Michigan. An estimated 20-25,000 acres of trickle irrigation has been installed on stone fruit alone. Recent grower and experiment station research reports have indicated significant increases in yield and vegetative growth through the use of trickle irrigation. Soil moisture status and growth characteristics for cherry and peach trees were determined under laboratory, greenhouse and field conditions. Determinations were made such that daily and seasonal differences in plant development could be characterized. Water stress and recovery from stress was determined. Using this data base, the most promising existing and newly developed irrigation scheduling techniques were identified. At the onset of the project, a field trial comparing existing techniques was established and analyzed along with the plant stress data and compared to existing methods.
W84-04408

PHYSIOLOGICAL RESPONSE OF ST. AUGUSTINEGRASS TO IRRIGATION SCHEDULING,
Florida Univ., Gainesville. Dept. of Ornamental Horticulture.
C. H. Peacock, and A. E. Dudeck.
Agronomy Journal, Vol. 76, No. 2, p 275-279, March-April, 1984. 7 Fig, 4 Tab, 14 Ref.

Descriptors: *Irrigation requirements, *Plants, Water requirements, Irrigation programs, Turfgrass, St. Augustinegrass, Plant physiology.

Response of St. Augustinegrass to irrigation scheduling was studied during the summers of 1980 and 1981 on a loamy, siliceous, hyperthermic Grossarenic Palendult soil. An irrigation schedule of 2-, 3-, 4-, and 6-day intervals simulated conditions ranging from grass being under no water stress to severe water stress. Field plots were constructed to maintain an undisturbed soil profile that horizontally isolated adjacent plots to prevent lateral water movement. Irrigation treatments were implemented by irrigating with evapotranspiration estimates of 0.64 cm/day in 1980 and 0.38 cm/day in 1981 at either 2-, 3-, 4-, or 6-day intervals. Plots received equal volumes of water; only irrigation timing was varied. Turfgrass swards were evaluated on 12 day cycles under water stress prior to irrigation and after 24 hr of recovery following irrigation. Measured parameters included turfgrass quality, carbon exchange rates (CRE), evapotranspiration rates (ET), plant water potential component changes, and leaf diffusive resistance, and transpiration. The 6-day irrigation schedule caused a reduction in CER and ET and concurrent increase in stomatal resistance and a loss of turgor pressure prior to irrigation. Following irrigation, CER, and ET increased, turgor pressure increased, and diffusive resistance decreased during the 12 day cycle. Changes in CER under stress were accompanied by a lowering of leaf water potentials. However, the most important changes in leaf water potential values were the significant increases from preirrigation to recovery. This implies that St. Augustinegrass may be under water stress at high leaf water potentials. (Baker-IVI)
W84-04419

WATER TABLE DEPTH INTERACTION WITH NITROGEN RATES ON SUBIRRIGATED CORN,
South Carolina Agricultural Experiment Station, Clemson.
J. R. Woodruff, J. T. Ligon, and B. R. Smith.
Agronomy Journal, Vol. 76, No. 2, p 280-283, March-April, 1984. 4 Fig, 6 Tab, 13 Ref.

Descriptors: *Irrigation programs, *Nitrogen, *Corn, *Water table, Crop yield, South Carolina, Nitrogen loss, Drainage, Subirrigation, Nitrates.

Water table control for both drainage and subirrigation holds potential benefit to crop production on many soils with imperfect drainage. In this 3 year field study, four N rates were superimposed over three water table depths to test the effect of water table depth on corn response to N in a Chewacla silt loam. Water table depths were 0.35, 0.70, and 1.00 m and N rates were 0, 112, 224, and 336 kg/ha. The effects of N fertilization depended on the water table depth. For the 3 year means, quadratic regressions described the relationship between N rate and ear yield or leaf N for each water table depth except 1.00 m ear yield for which no response to N fertilizer was obtained. These findings support earlier reports that corn yields may decrease with water tables less than 0.75 m beneath the soil surface and offer as partial explanation the loss of N efficiency as the water table becomes too shallow. (Baker-IVI)
W84-04420

WATER RELATIONS AND NET PHOTOSYNTHESIS IN HYBRID GERANIUM,
Georgia Univ., Athens. Dept. of Horticulture.
A. M. Armitage, H. M. Vines, Z.-P. Tu, and C. C. Black.
Journal American Society of Horticultural Science, Vol. 108, No. 2, p 310-314, March, 1983. 8 Fig, 1 Tab, 14 Ref.

Descriptors: *Water stress, *Photosynthesis, *Plant growth, Geraniums, Water requirements, Soil water potential, Soil-water-plant relationships.

The relationships of net photosynthesis (Pn) to soil water potential, leaf diffusive resistance, leaf water potential, and relative water content were studied

with hybrid geranium grown under conditions of greenhouse pot cultures. Net photosynthesis went through 4 stages according to the effects of water stress on the plants. As water stress increased, Pn went from a steady-state maximum rate to slow decline, to rapid decline, to total inhibition. During rapid Pn decline, soil water potential rapidly decreased from -4 bars to -14 bars, and leaf diffusive resistance increased from 4 s/cm to 80 s/cm. Leaf water potential was -7 bars, and relative leaf water content was 81-87%. Leaf water potential appeared to be the best indicator of imminent Pn decline. After rewatering waterstressed plants, 3 days were required to elevate Pn to a steady-state maximum which was only 90% of the initial steady-state Pn. This work is of immediate interest in the production of geraniums. Although water stressed geranium plants do not visually show the classical symptoms of wilt due to their waxy cuticle, their rate of Pn rapidly declines. During geranium production attention must be paid to the watering regime, or a reduction of Pn will occur from which leaves will not fully recover. (Baker-IVI)
W84-04421

FIELD QUANTIFICATION OF CROP WATER STRESS,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
R. J. Reginato.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 3, p 772-775 and 781, May-June, 1983. 6 Fig, 14 Ref.

Descriptors: *Remote sensing, *Water stress, *Plant water potential, *Stomatal conductance, Cotton, Irrigation requirements, Vapor pressure, Crop water stress index, Plant temperature.

Remotely sensed plant temperature was used as a primary factor for evaluating crop stress by by use of a crop water stress index (CWSI). The CWSI is related to two physiological parameters commonly used to quantify plant stress: leaf water potential and stomatal conductance. Leaf water potential was inversely related to the air vapor pressure deficit under well-watered conditions in cotton. Subtracting this atmospheric-induced leaf water potential from the total potential, resulted in a soil-induced leaf potential, which appears to be inversely linearly related to the crop water stress index. Leaf stomatal conductance was also inversely related to the CWSI. As the index increased from zero to 0.20, the conductance decreased from its maximum value of 2.6 cm/s to about 12 cm/s. The value of the CWSI is shown in terms of scheduling irrigations and predicting lint cotton yield. (Moore-IVI)
W84-04440

PROLINE ACCUMULATION AND RELATIVE WATER CONTENT IN SOYA BEAN (GLYCINE MAX) VARIETIES UNDER WATER STRESS,
Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (India). Dept. of Plant Breeding and Genetics.
B. B. Singh, and D. P. Gupta.
Annals of Botany, Vol. 52, No. 1, p 109-110, July, 1983. 1 Tab, 14 Ref.

Descriptors: *Water stress, *Proline, *Soybeans, Crop yields, Drought resistance.

Water stress causes several-fold accumulation of free proline in leaves of many plant species, and it has been suggested that this phenomenon can be used to screen crop cultivars for drought resistance. The effects of water stress on proline accumulation and relative water content of four soya bean varieties were studied. Two local strains, Kalitur and T-49 showed a smaller increase in proline content and greater reduction in relative water content than did JS-2 or Bragg under the same conditions of stress. These findings suggest that the accumulation of free proline by plants subjected to water stress may be used as an index for screening soya bean cultivars for drought tolerance. (Baker-IVI)
W84-04526

ABSCISIC ACID AND WATER RELATIONS OF RICE (ORYZA SATIVA L.): EFFECTS OF DROUGHT CONDITIONING ON ABSCISIC ACID ACCUMULATION IN THE LEAF AND STOMATAL RESPONSE,
Agricultural Research Council, Trumpington (England).Plant Breeding Inst.
I. E. Henson.
Annals of Botany, Vol. 52, No. 2, p 247-255, August, 1983. 5 Fig, 2 Tab, 26 Ref.

Descriptors: *Abscisic acid, *Rice, *Drought conditioning, *Accumulation, *Stomatal transpiration, Water stress, Turgidity, Stomata.

The effects of a period of water stress (drought conditioning) on responses to a second (challenge) stress were examined in young vegetative rice (Oryza sativa L.) plants. Drought conditioning did not affect the rate of subsequent stress development, nor, in a first experiment, did it influence relations between turgor (psip) and total (psi) leaf water potential. However, conditioning did extend the range of psip over which stomata remained open and significantly reduced the amount of ABA which accumulated in the leaf at a given psip. The change in stomatal behavior (stomatal adjustment) was quantitatively accounted for by the change in leaf ABA accumulation. The reduction in ABA accumulation due to conditioning did not involve a change in the potential capacity to produce ABA, as ABA accumulation in partially dehydrated detached leaves was not reduced by conditioning. It is suggested that effects of conditioning on leaf ABA content in the intact plant involve changes in the rate of ABA export from the leaf. (Author's abstract)
W84-04527

ABSCISIC ACID ACCUMULATION IN DETACHED LEAVES OF RICE (ORYZA SATIVA L.) IN RESPONSE TO WATER STRESS: A CORRELATION WITH LEAF SIZE,
Agricultural Research Council, Trumpington (England).Plant Breeding Inst.
I. E. Henson.
Annals of Botany, Vol. 52, No. 3, p 385-398, September, 1983. 9 Fig, 3 Tab, 27 Ref.

Descriptors: *Abscisic acid, *Accumulation, *Water stress, *Leaf size, *Correlation analysis, *Rice, Leaves, Water potential.

When water stress was imposed on detached leaves of two rice (Oryza sativa L.) cultivars, more ABA per unit fresh weight accumulated in IR20, a small-leaved cultivar, than in 63-83, a large-leaved cultivar; the difference being up to threefold. In an F2 population of a cross between the two cultivars ABA accumulation was found to be significantly negatively correlated with leaf fresh weight. This correlation persisted in the F3 generation. Such a correlation was not evident, however, when a number of rice cultivars, which varied widely in leaf size, were examined. The difference in ABA accumulation between IR20 and 63-83 was not accounted for by different spatial patterns of water loss or ABA accumulation within a leaf, and cultivar differences in ABA content were maintained both across, and at various positions along the leaf. No major differences in leaf anatomy were observed between the two cultivars. Differences found in leaf water relations characteristics were few and generally minor. It therefore seems unlikely that these properties account for the difference between the cultivars in the ability to accumulate ABA or for the correlation with leaf size. (Author's abstract)
W84-04528

A MODEL OF COMPETITION BETWEEN TREES AND GRASS FOR RADIATION, WATER AND NUTRIENTS,
Commonwealth Scientific and Industrial Research Organization, Hobart (Australia). Div. of Forest Research.
R. McMurtrie, and L. Wolf.
Annals of Botany, Vol. 52, No. 4, p 449-458, October, 1983. 3 Fig, 34 Ref.

Descriptors: *Model studies, *Trees, *Grass, *Radiation, *Water requirements, *Nutrients, Nutrient requirements, Mathematical models, Plant competition, Competing use, Carbon, Photosynthesis.

Plants often compete by depleting resources required by neighbors. The resources for which this competition is most important are radiation, water and nitrates. Conditions for the coexistence of trees and grass are explored using a mathematical model describing plant competition for radiation, water and nutrients. The model describes growth of both species in terms of key physiological processes (radiation interception, photosynthesis, respiration, grazing, litterfall, assimilate partitioning, nutrient uptake and water use) and is used to analyze how species compete by depriving each other of resources essential for growth. Changes of growth parameters are shown to lead to shifts in species composition (e.g. through replacement of one species by another). (Murphy-IVI)
W84-04529

COMPARISON OF THE EFFECTS OF WATER STRESS ON THE ROOT SYSTEMS OF TWO CULTIVARS OF UPLAND RICE (ORYZA SATIVA L.),
CEA Centre d'Etudes Nucleaires de Cadarache, Saint-Paul-les-Durance (France).
J. F. Bois, and P. H. Couchat.
Annals of Botany, Vol. 52, No. 4, p 480-487, October, 1983. 4 Fig, 2 Tab, 25 Ref.

Descriptors: *Comparison studies, *Water stress, *Roots, *Rice, Neutron radiography, Drought resistance, Root development.

In West Africa and especially in the Ivory Coast, rainfall is very irregular and the soil used for cultivation of upland rice usually has a low water table. Harvesting is affected when a drought period, even of short duration, occurs at a crucial time in the life cycle. Neutron radiography was used to study root development in upland rice (Oryza sativa L.) during and after a short period of drought. The limit of resolution (approx. 0.1 mm) of the method allows for the study of the adventitious root system in rice during the tillering stage. However the resolution is not sufficient to study development of the seminal system. Enlargement of neutron radiographs shows further details of primary root system. Thirty-six-day-old seedlings of two rice cultivars were subjected to a 4-day water stress followed by rewatering. Neutron radiography dehydration and inhibition of root growth during water stress. During post-drought rewatering, the two cultivars behaved differently with regards to the secondary root growth recovery. (Murphy-IVI)
W84-04530

NITROGEN UPTAKE BY WHEAT IN RELATION TO WATER REGIME AND DEPTH OF N PLACEMENT IN A LOAMY SAND SOIL: MEASUREMENT AND MODEL SIMULATION,
Indian Agricultural Research Inst., New Delhi.
B. R. Sharma, and T. N. Chaudhary.
Journal of Soil Science, Vol. 35, No. 1, p 141-148, March, 1984. 5 Tab, 17 Ref.

Descriptors: *Nitrogen, *Simulation, *Model studies, *Loamy sand, *Wheat, *Soil-water-plant relationships, Fertilization, Soil organic matter, Mathematical equations.

Nitrate-N distribution in soil, root-length, rate of water uptake and flux of nitrate-N to wheat roots as unfluenced by moisture regime and depth of nitrogen placement were studied in 60 cm diameter by 180 cm deep metal columns filled with loamy sand soil. The contribution of the different soil depths in the root zone towards total N uptake was calculated employing a convective-diffusion model and compared with the experimentally measured N uptake by wheat plants. Under non-irrigated conditions with surface-mixing of N(Ns) concentrations of nitrate, root-lengths and water uptake rates were high only in the upper soil layers. With deep placement of N(Nd), the lower layers also contributed significantly towards total N uptake and total N uptake was greater with Nd than with Ns. The deep placement of fertilizer N in coarse textured

soil results in its more uniform distribution in the root zone, more extensive root proliferation and enhanced sub-soil water utilization. It should ensure a greater nitrogen uptake by roots as they would encounter a nitrogen rich zone. It is likely to be of great importance when post-seeding surface irrigation or rainfall is not available. In spite of many simplifying assumptions and certain estimates the predicted values of N uptake were quite close to those measured experimentally. (Murphy-IVI)
W84-04578

WATER UPTAKE BY ROOTS CONTROLS WATER TABLE MOVEMENT AND SEDIMENT OXIDATION IN SHORT SPARTINA MARSH,
Woods Hole Oceanographic Institution, MA. Dept. of Biology.
For primary bibliographic entry see Field 2L.
W84-04767

DIURNAL VARIATIONS IN LEAF WATER POTENTIAL AND STOMATAL CONDUCTANCE OF PIGEON PEA (CAJANUS CAJAN (L.) MILLSP.) CULTIVARS AS AFFECTED BY IRRIGATION LEVELS,
Haryana Agricultural Univ., Hissar (India). Dept. of Agronomy.
K. P. Singh, R. S. Malik, and D. S. Malik.
Biologia Plantarum (Praha), Vol. 25, No. 1, p 1-4, 1983. 2 Fig, 6 Ref.

Descriptors: *Water potentials, *Stomatal conductance, Pigeon pea, Diurnal variations, Irrigation effects, Crop yield, Drought tolerance.

Pigeon pea (Cajanus cajan) is grown in northwest India during the rainy season. The crop suffers due to water stress when the monsoon rains are over. This period coincides with the reproductive stage of the crop, and water stress at this stage results in the maximum loss in production. Two cultivars of pigeon pea, UPAS-120 and Parbhat, were grown in the field under two irrigation treatments: no irrigation and irrigation when cumulative pan evaporation was equal to 50% depletion of available water content in one meter root zone depth. Diurnal changes in leaf water potential and stomatal conductance were recorded on two days i.e. October 1, 1979 and October 28, 1979 which corresponded to reproductive growth stage of the crop. Plant water potential decreased rapidly during the day up to about 1500 hr and increased during evening hours. Higher leaf water potential was recorded in irrigated treatment on both dates. Adaxial stomatal conductance started declining during early morning hours, however, abaxial conductance increased up to 0900 hr then decreased and increased again in the afternoon except in irrigated crop of cv. UPAS-120 on 28th October, where conductance never increased after 0900 hr. The reduced rate of stomatal conductance during day hours may be identified as one of the characteristics responsible for drought tolerance in pigeon pea. (Moore-IVI)
W84-04771

WATER RELATIONS PATTERN OF UNDERSTOREY SPECIES INFLUENCED BY SUNFLECKS,
Slovenska Akademia Vied, Bratislava (Czechoslovakia). Ustav Experimentalenj Biologie a Ekologie.
P. Ellias.
Biologia Plantarum (Praha), Vol. 25, No. 1, p 68-74, 1983. 4 Fig, 1 Tab, 24 Ref.

Descriptors: *Solar radiation, *Understory, *Transpiration rate, *Stomatal conductance, Forests, Irradiance, Canopy.

Irradiance (I) in a plant community is characterized by very large temporal and spatial variability. The uneven distribution of I in the understory of a forest stand is due to penetration of direct beam radiation through canopy openings (occurrence of sunflecks). Water relations of plant cenopopulations of understorey species (7 herbaceous perennials, 1 shrub, and 1 tree seedling) growing in an oak-hornbeam forest in SW Slovakia (Czechoslovakia) is markedly influenced by natural sunflecks moving on the forest floor, where stomatal conductance and transpiration rate are significantly higher than in shade areas. In the course of a day, the leaf stomatal conductance fluctuates, following irradiance of the leaf, from minimum in full shade to maximum in sunflecks, including intermediate values in transient conditions. Therefore, there is also a large variability in water saturation deficit and transpiration rate within the cenopopulations of the understorey species. These variations should be considered in modelling the physiology of woodland understorey species. (Moore-IVI)
W84-04772

EFFECT OF CALCIUM ON WATER-STRESS-INDUCED BIOCHEMICAL CHANGES AND YIELD OF FIELD-GROWN RICE,
Burdwan Univ. (India). Plant Physiology and Biochemistry Lab.
For primary bibliographic entry see Field 3F.
W84-04773

EFFECTS OF WIND VELOCITY ON STOMATAL CONDUCTANCE AND CONSEQUENCES OF LEAF ROLLING ON WATER UPTAKE IN TALL FESCUE,
Universite Catholique de Louvain, Louvain-la-Neuve (Belgium).
C. Renard, and W. Demessemacker.
Biologia Plantarum (Praha), Vol. 25, No. 6, p 408-411, 1983. 1 Fig, 2 Tab, 9 Ref.

Descriptors: *Transpiration, *Water loss, *Leaf rolling, *Stomatal conductance, *Fescue, Leaves, Plants, Wind velocity, Stomatal transpiration, Water conservation, Grasses.

Leaf form and stomatal characteristics play an important part in the strategy of tall fescue to limit water losses. The effect of leaf rolling on transpiration of tall fescue leaves is considered. Fully expanded leaves of tall fescue were used for the measurements. Total diffusive conductance, obtained by adding conductance of adaxial and abaxial faces, is significantly affected at values of wind speed of 3 m/s. Effect of leaf rolling was studied only at degrees 1, 3, and 5 owing to the difficulty of simulating other degrees. When leaf is rolled at degrees 3 and 5, water uptake ratio was decreased by 65% at values of wind speed of 21 m/sec. At high wind velocities, water uptake is increased a 2 m/sec and decreased at 3 m/sec when the leaf is unrolled. Results thus confirm that leaf rolling is effective in decreasing water uptake by individual leaves and that leaf transpiration rate is affected. (Baker-IVI)
W84-04774

RELATIONSHIP BETWEEN SOIL MOISTURE AND LEAF WATER POTENTIAL OF THREE FOREST TREE SPECIES,
Slovenska Akademie Vied, Bratislava (Czechoslovakia). Ustav Hydrologie a Hydrauliky.
J. Huzulak, and F. Matejka.
Biologia Plantarum (Praha), Vol. 25, No. 6, p 462-467, 1983. 1 Fig, 9 Ref.

Descriptors: *Plant water potential, *Soil water, Trees, Mathematical models, Oak, Maple, Hornbeam, Vapor pressure deficit, Wilting, Drought resistance.

A mathematic model of leaf water potential daily dynamics was employed to study the relationship between this characteristic and soil moisture for the species Quercus cerris, Acer campestre and Carpinus betulus. It was found that when evaluating the availability of soil water for a plant it is necessary to consider the vapor pressure deficit which remarkably affects the relationship between the soil moisture and leaf water potential. A quantitative description of the dependence between the leaf water potential and soil moisture enabled a physiological interpretation of the limit values of soil moisture - permanent wilting and reduced availability of soil water for the plant - as well as evaluation of drought resistance of plants. (Author's abstract)
W84-04775

DIURNAL VARIATION IN LEAF WATER POTENTIAL, STOMATAL CONDUCTANCE, AND IRRADIANCE OF WINTER CROP UNDER DIFFERENT MOISTURE LEVELS,
Haryana Agricultural Univ., Hissar (India). Dept. of Agronomy.
For primary bibliographic entry see Field 3F.
W84-04776

AN IMPROVED SYSTEM OF SUBJECTING PLANTS TO WATER STRESS,
Allahabad Univ. (India). Plant Physiology Lab.
P. N. Singh, R. Prasad, M. Salim, and A. Sharga.
Biologia Plantarum (Praha), Vol. 26, No. 1, p 16-21, 1984. 1 Fig, 1 Tab, 14 Ref.

Descriptors: *Water stress, *Plant growth, *Translocation, Plant physiology, Barley, Nitrogen, Phosphorus, Polyethylene glycol.

An improved system of plant cultivation at stable and specific levels of polyethyleneglycol (PEG, mol. mass 1400-1600) - induced water stress has been described. To set up this system a perforated tubular glass vessel containing soil to support seedling growth was wrapped externally first with a layer of macroporous silica gel-G and then with three layers of a dialysis membrane of a lower exclusion limit (200 mol. mass). Effects of 8 days of PEG - induced stress have been studied on uptake and translocation of N and P and growth of barley (Hordeum vulgare L. cv. KN 16) seedlings. Some of the noteworthy improvements of the system were exclusion of PEG from the plant consequent upon use of silica gel-membrane combination, shorter time (2 days) for the soil-plant-air continuum to attain steady state and stability of the plant water potential over a period of a few days. (Author's abstract)
W84-04777

2J. Erosion and Sedimentation

DIVERSION WORKS AND SEDIMENT TRANSPORT (OUVRAGES DE DERIVATION ET TRANSPORTS SOLIDES),
For primary bibliographic entry see Field 8B.
W84-04221

SOLUTE RELEASE AND SEDIMENT ENTRAINMENT ON MICROCATCHMENTS IN THE DINOSAUR PARK BADLANDS, ALBERTA, CANADA,
Toronto Univ. (Ontario). Dept. of Geography.
R. B. Bryan, A. C. Imeson, and I. A. Campbell.
Journal of Hydrology, Vol. 71, No. 1-2, p 79-106, March 15, 1984. 9 Fig, 8 Tab, 27 Ref.

Descriptors: *Sedimentation, *Entrainment, *Microcatchments, *Solute transport, *Dinosaur Park Badlands, *Alberta, *Canada, Storm runoff, Sodium montmorillonite, Hydrographs.

The uptake of solutes and entrainment of sediments in runoff generated by simulated rainstorms on different badland surfaces, and the properties of the regolith materials related to solute uptake are described and studied in a number of simple laboratory experiments. Field and laboratory results are in close agreement. Runoff, solute and sediment uptake are profoundly influenced by the large amounts of sodium montmorillonite present in the regolith. Shale surfaces, although responding late to rainfall, release increasing amounts of sediment and solutes (sodium and sulfate) as they swell and increase in erodibility. On other surfaces low rates of rainfall acceptance are caused by the secretion of montmorillonite gels, and there is a gradual decrease in solute and sediment concentration as accumulated salts are flushed from the surface. The effect of the chemistry of the simulated rainfall on the experiment results is examined. It is considered possible to characterize the pattern of solute and sediment uptake on the different badland surfaces and to apply this information to the identification of runoff sources in mesoscale drainage basins and to the routing of storm runoff. (Murphy-IVI)
W84-04302

PRELIMINARY ESTIMATES OF LOADS CARRIED BY RIVERS TO ESTUARIES AND COASTAL WATERS AROUND GREAT BRITAIN DERIVED FROM THE HARMONIZED MONITORING SCHEME,
For primary bibliographic entry see Field 5B.
W84-04316

SEDIMENTATION PROCESSES IN THE BRISTOL CHANNEL/SEVERN ESTUARY,
Institute of Oceanographic Sciences, Taunton (England).
For primary bibliographic entry see Field 2L.
W84-04334

PHYSICAL AND CHEMICAL PROPERTIES OF ERODED SOIL AGGREGATES,
Agricultural Research Service, Columbia, MO. North Central Watershed Research Center.
E. E. Alberts, R. C. Wendt, and R. F. Piest.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 2, p 465-471, March-April, 1983. 4 Fig, 4 Tab, 34 Ref.

Descriptors: *Soil aggregates, *Iowa, *Soil erosion, Rill erosion, Interrill erosion, Clay, Nitrogen, Phosphorus, Sediment transport, Loess soils, Simulated rainfall.

Rainfall simulation was used to evaluate the characteristics of aggregates eroded from erosion plots on two loess soils in southwestern Iowa. The mean aggregate diameters (D50) for interrill erosion were 44 and 34 micro m for soils with 26% clay and 1.9% carbon and 22% clay and 0.8% carbon in their matrix, respectively. The D50 size increased as rilling occurred, but the percentage of increase was quite different for the soils. The D50 size increased by 91% for the soil with higher clay, whereas it increased by only 15% for the other soil. The eroded aggregates >50 micro m in diameter contained more clay and total nitrogen than did the aggregates <50 micro m, when analyzed as a single fraction. The >50-micro m aggregates were also enriched in clay and nitrogen when their contents were compared to those of the matrix soil. Enrichment was greater for interrill than for interrill plus rill erosion because of greater particle selectively during the transport process. Equilibrium phosphorus concentration curves varied with aggregate size, suggesting that 250 to 50-micro m aggregates are of greater importance in buffering soluble P levels and transporting labile P than larger aggregates. (Author's abstract)
W84-04430

EVALUATION AND COMPARISON OF TWO METHODS FOR CHARACTERIZATION OF SEDIMENT SIZE DISTRIBUTION,
Purdue Univ., Lafayette, IN. Dept. of Agricultural Economics.
W. H. Neibling, W. C. Moldenhauer, and B. M. Holmes.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 2, p 472-480, March-April, 1983. 13 Fig, 4 Tab, 11 Ref.

Descriptors: *Sediments, *Soil erosion, *Particle size, Soil aggregates, Storage time, Sample preparation, Decantation, Pipetting.

The effect of storage time on aggregate size analysis and two methods of analysis (pipette and decantation) to separate naturally eroded sediment into 11 size fractions ranging from <2 micro m to 35 micro m are described. Five sets of 49 samples each from Indiana soils were used to test if storage times of 0, 1, 2, 3, 7, 30 or 180 days before particle size separation was performed caused significant differences in the measured particle size distribution for either of the two methods. For samples between 35 and 500 micro m (separated by wet sieving in the laboratory) effects of storage time on the particle size distribution were significant after 30 days. For the size fractions smaller than 35 micro m separated by pipette storage time was significant after 30 days. Storage time was significant after 180 days only in 3 of 20 storage time-size fraction combinations for the decantation method. Differences in the percent of sediment found in each size class between the two methods were highly significant for each size fraction <35 micro m for all five soils. Differences of 20 mm in the effective depth range actually sampled by the pipette and differences from 8 to 18 s between times required to fill the 10 mL pipette did not significantly affect particle size. Increasing pipette withdrawal depth from 50 to either 100 or 150 mm essentially doubled the dry weight of soil obtained in a pipette for the 20 to 35 micro m fraction. Results using the same withdrawal depths for <2, 2 to 10, and 10 to 20 micron fractions showed only minor differences between depths. (Author's abstract)
W84-04431

POSSIBLE ERRORS DURING FIELD EVALUATIONS OF SEDIMENT SIZE DISTRIBUTIONS,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
L. D. Meyer, and S. H. Scott.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 2, p 481-486, March-April, 1983. 5 Tab, 13 Ref.

Descriptors: *Sediments, *Sediment erosion, *Particle size, *Sample preparation, Runoff, Field tests.

The size distribution of sediment eroded during rainstorms is an important factor affecting the transportability of such sediment. Since sediment samples from some soils may either break down further or reaggregate during storage, it is preferable to make sediment-size evaluations immediately after collection. Field analyses of size distributions of sediment from aggregated soils necessarily involve conditions that may adversely affect the resulting data. Most of these conditions can cause inaccurate sieving and pipetting, so wet sieving and pipette withdrawal techniques are described that help minimize errors. Experiments were conducted to evaluate the effects of air and water temperature variations, different sediment sample size, variable pipette withdrawal depths, and vibrations from pumps and motors. For the range of such conditions encountered during field research, only insufficient sediment in the runoff samples that caused very low sediment concentrations for the pipette analysis showed evidence of seriously affecting the resulting sediment size distributions. Sediment size distributions can be made accurately in the field if suitable equipment and good quality water are used, proper procedures are followed carefully, and certain potential problems are avoided. (Moore-IVI)
W84-04432

MEASUREMENT OF FINE SILT AND CLAY SIZE DISTRIBUTIONS,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
F. R. Schiebe, N. H. Welch, and L. R. Cooper.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 2, p 491-496, March-April, 1983. 2 Fig, 1 Tab, 6 Ref.

Descriptors: *Sediments, *Particle size, *Clay, *Silt, Lake sediments, Mathematical methods.

Three different commercial particle-size analyzers were compared with the conventional pipet technique to measure the size distributions of samples of very fine sediments. The Electrozone system operates on the principal of electrical conductivity change caused by particles moving through a small orifice. The Sedigraph is based on the gravitational settling in Stokes range and mass determination by x-ray attenuation. The Model 7991 Microtrac uses detection of the intensity and scattering angle of laser light by particles. The 15 samples were obtained from the deposited sediments in several oxbow lakes in the alluvial plain in west central Mississippi. Approximately 90% of the material in these samples were less than 10 micro m in size. The basic features, principles and underlying assumptions for each instrument are outlined and compared for all analyzers and techniques used. While the results from the four methods showed drastic differences, reconciliation of this data was achieved by use of simple mathematical descriptions of the particle size distributions and of the measurement processes involved with each instrument. (Moore-IVI)
W84-04433

RAINFALL CHARACTERISTICS AND THEIR RELATION TO SPLASH EROSION,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2B.
W84-04443

DEPOSITION OF NONUNIFORM SEDIMENT ON CONCAVE SLOPES,
Soil Conservation Service, West Warwick, RI.
S. S. Davis, G. R. Foster, and L. F. Huggins.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 4, p 1057-1063, July-August, 1983. 8 Fig, 4 Tab, 23 Ref.

Descriptors: *Overland flow, *Sediment deposition, *Slopes, Aggregates, Coal, Sand, Specific gravity, Sediment yield, Sediment transport.

A laboratory study was conducted to investigate behavior of simulated natural sediments transported and deposited by overland flow on concave slopes. Natural sediment is a heterogeneous mixture of primary particles and aggregates having nonuniform distributions of diameter and density. Coal as aggregate substitutes and sand were studied both as separate homogeneous sediments and combined as hetergeneous sediment mixtures. Specific gravity was more important than diameter in the transport and deposition of different particles types in a mixture. The particles with the lower specific gravity traveled much further downslope before being deposited than did the particles with the higher specific gravity. Before considerable sediment was deposited on the slope, most of the sediment yield was particles having the smaller specific gravity. As deposited sediment accumulated, the portion of sediment yield consisting of sediment with the larger specific gravity increased. (Author's abstract)
W84-04448

EROSION OF SOIL AND POULTRY MANURE - A LABORATORY STUDY,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W84-04450

SOIL ERODIBILITY VARIATION DURING THE YEAR,
Science and Education Administration, Oxford, MS. Sedimentation Lab.
C. K. Mutchler, and C. E. Carter.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 4, p 1102-1104 and 1108, July-August, 1983. 9 Fig, 3 Tab, 13 Ref.

Descriptors: *Soil erosion, *Soil loss, *Air temperature, Erodibility, Soil water, Holly, Mississippi, Morris, Minnesota.

Current usage of the K factor in the Universal Soil Loss Equation assumes that soil has an inherent erodibility that is constant throughout the year. The variable erodibility of soil due to variations in soil moisture, especially, does not allow accurate soil loss estimates for periods shorter than a year unless this variability is accounted for directly or indirectly by some other soil erosion factor. Six years of data from erosion plots at Holly Springs, MS, and 10 yr of data from plots at Morris MN, were used to study variation in soil erodibility through the year. Monthly values of soil erodibility were related to time with a cosine curve. Erodibility varied from a high of 169% of annual average K (K of the Universal Soil Loss Equation) on February 4 to a low of 31% of annual average on August 5 for the Mississippi data. Minnesota erodibility data were described similarly except the maximum and minimum of the erodibility function lagged the Mississippi curve by about 2 months. For predicting erodibility, normal monthly air tem-

peratures were found to be well represented by a cosine function different from the erodibility function only in amplitude and initial time. (Moore-IVI)
W84-04453

CHANNEL MORPHOLOGY CHANGES AND SEDIMENT YIELD FOR A SMALL AGRICULTURAL WATERSHED IN IOWA,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. M. Hamlett, J. L. Baker, and H. P. Johnson.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 5, p 1390-1396, September-October, 1983. 8 Fig, 3 Tab, 18 Ref.

Descriptors: *Agricultural watersheds, *Sediment yield, *Channel morphology, *Iowa, Land use, Row-crops, Snowmelt, Runoff, Soil erosion, Sediment transport, Sediment deposition.

Channel widths, depths, and cross-sectional areas were measured at several locations on a stream draining a 50.5-sq km agricultural watershed in east-central Iowa several times during the 1964 to 1980 period. Land use became more row-crop intensive during this period, with the channel progressively increasing in width and depth. The average annual increase in channel area from 1964 to 1980 was 2.7% (0.29 sq m/yr), with the larger increases in channel dimensions associated with the 1977 to 1980 period. Runoff and sediment loads from the watershed, and field subwatersheds, were investigated for 1976 to 1980. At the field subwatersheds, snowmelt runoff was a sizeable portion of total annual runoff, yet erosion and sediment transport with snowmelt was minimal. For the stream, snowmelt sediment load (as a percentage of the total annual load) was larger than at the field sites, suggesting the possible reentrainment by snowmelt of previously deposited sediment. However, cross-sectional data for 1964 to 1967 did not substantiate the hypothesis of sediment deposition in the stream channel during the summer, with subsequent flushing of deposited sediment during snowmelt. Average sediment load attributable to channel contributions was estimated to be at least 25%. (Author's abstract)
W84-04463

CHARACTERISTICS OF RAINDROP THROUGHFALL UNDER CORN CANOPY,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
N. W. Quinn, and J. M. Laflen.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 5, p 1445-1450, September-October, 1983. 1 Fig, 2 Tab, 12 Ref.

Descriptors: *Drop size, *Drop velocity, *Throughfall, *Canopy, Soil erosion, Kinetic energy, Stemflow, Corn, Simulated rainfall, Erosivity.

A better understanding of the drop size and drop velocity characteristics of rainfall passing through crop canopy (throughfall) is needed to estimate throughfall erosivity (kinetic energy) and to test the assumptions upon which the canopy subfactor model of the Universal Soil Loss Equation (USLE) is based. A laboratory rainfall simulator was used to study the raindrop size and velocity under a corn canopy. The kinetic energy of throughfall relative to the kinetic energy of the simulated rainfall without a crop was compared for various row spacings, crop stages, and positions within the row. Drop sizes were measured by using a dye-paper technique, and drop velocities were measured photographically. Stemflow was calculated on the basis of rainfall under the canopy and incident rainfall above the canopy. Up to 49% of incident rainfall appeared as stemflow. Drops that directly penetrated the crop canopy accounted for much of the throughfall kinetic energy; drips from leaf margins also contributed greatly to throughfall kinetic energy. Drops that splashed from leaves were quite small and contained little kinetic energy. There was little difference between throughfall kinetic energy predicted by the USLE canopy subfactor model and those measured in this experiment even though a considerable range in canopy heights and canopy covers was experienced. The importance of drops falling from leaf margins as elements of throughfall erosivity might increase outdoors where raindrops are smaller than the drop from the simulated rainfall used for this experiment. (Moore-IVI)
W84-04471

RESPONSE OF AGGREGATED SEDIMENT TO RUNOFF STRESSES,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
F. E. Rhoton, L. D. Meyer, and F. D. Whisler.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 5, p 1476-1478, September-October, 1983. 1 Fig, 1 Tab, 9 Ref.

Descriptors: *Rainfall impact, *Rill erosion, *Sediment erosion, Aggregates, Sediment size, Rainstorms, Agricultural runoff.

Aggregated sediment was subjected to stimulated runoff stresses to determine if sediment sizes eroded by raindrop impact decreased during the runoff process. The sediment was stressed in a square, continuous channel which could be rotated to simulate rill flows of 0.14, 0.28, and 0.56 m/s. Sediment sizes measured after stressing the sediment for 5 min at each flow rate were not appreciably different from reference (no-flow) sediment sizes, with the exception of one soil. The only decrease in sediment sizes occurred when the flow time at the 0.56 m/s rate was increased to 60 min. Apparently, aggregated sediment eroded by intense rainstorms undergoes little if any additional breakdown during transport by runoff through flow systems common in agricultural fields. (Author's abstract)
W84-04475

SLOPE STEEPNESS AND INCORPORATED RESIDUE EFFECTS ON RILL EROSION,
Agricultural Research Service, Columbia, MO.
M. W. Van Liew, and K. E. Saxton.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 6, p 1738-1743, November-December, 1983. 6 Fig, 4 Tab, 10 Ref.

Descriptors: *Rill erosion, *Slope, *Crop residues, Straw, Soil erosion, Tillage, Runoff rate, Shear stress, Agricultural runoff.

In many locations, rill erosion is the most significant form of soil loss, but research has not separated the quantity of rill and interrill erosion when defining the effects of factors such as topography and soils. A controlled field experiment was conducted to determine the effect of runoff rate, slope steepness and incorporated residue on rill erosion. The effect of raindrop impact was minimized. Duplicate rills were tested on slopes of 9, 18, and 23%, each with incorporated wheat straw residue of about 0, 4700, and 9400 kg/ha, and two flow rates. Rill erosion by runoff without accompanying rainfall was related to slope steepness. Rill erosion varied directly with flow shear stress, but rill geometry depended on other processes, such as rill head cutting and slumping of undercut sideslopes. Rill detachment rates were reduced nearly 60% by the medium residue treatment and about 85% by the high residue treatment when compared with the no-residue treatment. The incorporated residue affected rill erosion by reducing the flow shear stress, acting as a binding agent to increase the resistance of the soil to erosion, and providing miniature grade control structures to provide depositional sites for detached soil. Tillage practices which incorporate residue into the tilled soil layer may substantially reduce soil losses from rill erosion. The results are applicable to the Universal Soil Loss Equation C-factor related to rill erosion in areas where rainfall does not significantly effect rill erosion. (Moore-IVI)
W84-04482

DISTRIBUTED PARAMETER MODELING OF SEDIMENT MOVEMENT AND PARTICLE SIZE DISTRIBUTIONS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Engineering.
T. A. Dillaha, III, and D. B. Beasley.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 6, p 1766-1772 and 1777, November-December, 1983. 2 Fig, 3 Tab, 26 Ref.

Descriptors: *Particle size, *Sediment transport, *Sediment erosion, *Mathematical models, Construction sites, Watersheds, Erosion control, Overland flow, Interception, Infiltration, Subsurface drainage.

A spatially descriptive erosion submodel for estimating the particle size distribution of eroded sediment from disturbed upland watersheds and construction sites has been developed and incorporated into the ANSWERS watershed model. Model validation is accomplished using data from field plot studies. The model's usefulness as an erosion control planning tool is demonstrated on a construction site in central Indiana. The model divides the watershed into a uniform grid of square planar elements. Within each element, the model describes the processes of interception, infiltration, surface storage, surface flow, subsurface drainage, and sediment detachment, transport and deposition. The continuity equation is then used to integrate the individual elemental responses into a system response that describes the watershed as a whole. The erosion process is limited to the overland flow regime. (Author's abstract)
W84-04484

CHANGES IN HUMUS IN LEACHED CHERNOZEMS CAUSED BY EROSION,
A. A. Tanasiyenko.
Soviet Soil Science, Vol. 15, No. 2, p 78-87, 1983. 6 Tab, 15 Ref. Translated from Pochvovedeniye, No. 4, p 116-125, 1983.

Descriptors: *Humus, *Soil erosion, *Chernozems, Agricultural runoff, Kuznetzk Basin, Soil loss, Storm runoff, Leaching, Plowing, Slope.

Changes in the composition of humus in the plowed and subsoil horizons of leached Chernozems subjected to water erosion in the Kuznetzk basin are considered. Leached Chernozems of the Kuznetsk basin have a high humus content. In the upper horizons of the soil profile it amounts to 8-13% and decreases rather abruptly downward in the profile. Moldboard plowing of slopes results in washing away every year the most fertile and humified particles and penetrating into the less humified layer. The long term effects of erosion and penetration into the soil layer depleted of humus contribute to a steady decrease in the humus content and reserves in the plowed layer and throughout the profile. Leached clayey loam Chernozems in the Kuznetsk basin lost, depending on the severity of erosion of the soil profile, 33 to 75% of the total humus reserves during the last 100 years, while the annual loss was 1000 kg from each hectare of soils on slopes. Humus in runoff products has the same features as soil humus. Most of the humus in the runoff products consists of humic acids. The carbon ratio of the humic acids to the fulvic acids varies from 1.3 to 2.0, depending on the soil moisture content and on the diameter of the particles involved. The amount of humus in the runoff products depended on the flow rate of the meltwater and rain water, whereas the composition of the organic matter in these products depended on the initial soil moisture. The composition of humic acids removed with the products of solid runoff is dominated by a mobile fraction bound to mobile sesquioxides. A characteristic of the organic matter in solid runoff products in wet soils is the unusually high content of mobile humic acids compared with plowed and especially the subsoil of noneroded and eroded Chernozems. (Baker-IVI)
W84-04522

SEDIMENT YIELD AND STORM FLOW RESPONSE TO CLEAR-CUT HARVEST AND SITE PREPARATION IN THE OUACHITA MOUNTAINS,
Weyerhaeuser Co., Hot Springs, AR. Southern Forestry Research Center.
E. L. Miller.

Water Resources Research, Vol. 20, No. 4, p 471-475, April, 1984. 3 Fig, 5 Tab, 8 Ref.

Descriptors: *Sediment yield, *Storm flow, *Clear-cutting, *Harvest preparation, *Site preparation, *Ouachita Mountains, Sedimentation, Storm runoff, Rainfall-runoff relationships, McCurtain County, Oklahoma.

Silvicultural activities used in even-aged forest management are relatively new in the Ouachita Mountains of Oklahoma and Arkansas. These practices include clear-cutting, mechanical site preparation, and planting of tree seedlings. The effects of these practices were examined. The results provide a measure of the effects of harvest and site preparation on soil erosion and water quality, an understanding of some hydrologic characteristics of small watersheds in the Ouachita Mountains, and a beginning point from which to evaluate soil loss models and erosion assessments for forestry. Clear-cut harvest and site preparation, including crushing the residual vegetation, burning, and contour ripping, were applied to three small watersheds in Oklahoma. Three undisturbed forested watersheds served as controls. First-year sediment losses averaged 282 and 36 kg/ha and storm flow water yields averaged 22.9 and 31/7 cm on clear-cut and uncut watersheds, respectively. The lower water yield on cut watersheds may have been due to contour ripping. Treatment differences in sediment yield were significant the second and third, but not the fourth, year following treatment. Storm flow water yield from clear-cut watersheds was significantly higher than from uncut watersheds the second year but not the third or fourth years. Absolute levels of sediment yield from clear-cut and control watersheds were relatively low in all years of the study. The overall impact of harvest and site preparation on total suspended solids levels in runoff was small and short-lived. (Murphy-IVI)
W84-04571

BED LOAD GRAIN VELOCITIES AND SEDIMENT TRANSPORT RATES,
State Univ. of New York at Binghamton. Dept. of Geological Sciences.
J. S. Bridge, and D. F. Dominic.
Water Resources Research, Vol. 20, No. 4, p 476-490, April, 1984. 6 Fig, 7 Tab, 109 Ref.

Descriptors: *Bed load, *Grain velocities, *Sediment transport, Fluid flow, Hydrodynamics, Mathematical equations.

When a fluid stream flows over a bed of loose sediment grains, fluid stresses at the sediment boundary may result in entraining of a finite number of grains, transporting them downstream. Theoretical consideration of the dynamics of bed load sediment transport leads to expressions for bed grain velocity and sediment transport rate. The grain velocity equation agrees well with all experimentally determined velocities of single grains moving over fixed rough beds if 'a' (a = 1)Karman constant ln (distance from boundary of effective fluid thrust on bed load grain)/roughness height) is allowed to vary with bed roughness and saltation height. Values of the critical shear velocity (at threshold of grain entrainment) for such overriding grains are substantially less than normally accepted values. The sediment transport rate equation predicts plane bed experimental data well, over five orders of magnitude of ib (ib = bed load transport rate as immersed weight passed per unit width). Values of 'a'/tan alpha increase significantly from lower to upper stage plane beds due to an increase in 'a' with suspended sediment concentration but also due to a decrease in tan 'a' with increasing transport stage and grain size (as predicted by Bagnold). (Murphy-IVI)
W84-04572

COAGULATION RATES OF CLAY MINERALS AND NATURAL SEDIMENTS,
Delaware Univ., Newark. Coll. of Marine Studies.
R. J. Gibbs.
Journal of Sedimentary Petrology, Vol. 53, No. 4, p 1193-1203, December, 1983. 15 Fig, 2 Tab, 37 Ref.

Descriptors: *Coagulation, *Clay minerals, *Sediments, Illite, Kaolinite, Montmorillonite, Salinity, Mathematical models, Particle size, Environmental effects, Sedimentation.

Coagulation experiments conducted using illite, kaolinite, montmorillonite, and four natural sediment samples in blade and Couette reactors with solutions of various salinities yielded collison-efficiency factors significantly higher than those in the previous literature, indicating that coagulation begins at lower salinities (1/2-1%). The natural sediments do not generally behave as might be predicted for a mixture of the standards of the minerals of which the natural sediment samples were comprised. The half-times for coagulation of the particles indicate that, in nature, the coagulation process would probably be completed in the first few parts-per-thousand salinity. (Murphy-IVI)
W84-04608

TEMPORAL, SPATIAL, AND TEXTURAL VARIATIONS IN THE MINERALOGY OF MISSISSIPPI RIVER SUSPENDED SEDIMENT,
Amoco Production Co., New Orleans, LA.
A. G. Johnson, and R. T. Kelley.
Journal of Sedimentary Petrology, Vol. 54, No. 1, p 67-72, March, 1984. 3 Fig, 2 Tab, 25 Ref.

Descriptors: *Temporal variation, *Spatial variation, *Textural variation, *Mineralogy, *Mississippi River, *Suspended sediments, Sediments, Particle size, Smectite, Illite, Kaolinite, Quartz, Plagioclase, Alkali feldspar, Chlorite, Amphibole.

It has long been known that as a result of frequent deposition the mineralogy of Mississippi River sands remains constant in time and space along the river. There has never been a comparable, detailed mineralogical study of the vastly more abundant muddy sediment of the river. To evaluate the magnitude of variation in Mississippi River fine-fraction mineralogy, suspended sediment was collected at 3 stations across the river during July and November 1980. Samples were disaggregated, and without pretreatment, separated into 4 sizes: 62.5-7.8 micro m; 7.8-2.0 micro m; 2.0-0.49 micro m; and less than 0.49 micro m. Using calibration curves prepared from pure minerals with an internal standard, XRD determinations of the mineralogy were obtained with a high precision. Minerals quantified were, in order of decreasing abundance: smectite, illite, kaolinite, quartz, plagioclase, alkali feldspar, chlorite, and amphibole. The largest source of variation in suspensate mineral abundance was sediment size. Smectite, for example, comprised 50% of the fine clay, but was not present in silt. ANOVA revealed significant temporal variation in the abundance of smectite and illite within the finest size and lateral variation in quartz and feldspar abundance in coarser sizes. Discriminant function analysis determined that the total mineralogy of river-suspended sediment varied significantly with time. This temporal variation in mineralogy apparently results from differences in soil mineralogy in drainage basins of the major tributaries of the river, coupled with the time-varying contributions of the tributaries. (Author's abstract)
W84-04609

SEDIMENT COMPOSITION AND HYDROGRAPHY IN SIX HIGH-GRADIENT ESTUARIES OF THE NORTHWESTERN UNITED STATES,
Oregon State Univ., Corvallis. School of Oceanography.
For primary bibliographic entry see Field 2L.
W84-04610

PISTON CORERS FOR PEAT AND LAKE SEDIMENTS,
Minnesota Univ., Minneapolis. Limnological Research Center.
H. E. Wright, Jr., D. H. Mann, and P. H. Glaser.
Journal of Ecology, Vol. 65, No. 2, p 657-659, April, 1984. 2 Fig, 5 Ref.

Descriptors: *Piston corers, *Peat, *Lake sediments, Stratigraphy, Sedimentology, Measuring instruments, Design, Performance evaluation.

Investigations of peat stratigraphy usually involve the use of the Davis sampler, which is easy to operate because of its small diameter (approximately 2 cm), or the Hiller side sampler, which has a sharpened flange along its length by which a core is drawn into the chamber from the side. The Russian or Macaulay corer, also a side sampler, has become popular in recent years. Piston corers of 5-cm diameter, designed for lake sediments, have also been used. None of these devices is uniformly successful in cutting the wood or undecomposed fibrous peat that characterizes especially the upper meter or two of many peat deposits. The blade on a side sampler is not sharp enough to cut wood or sedge stems and rhizomes, and as the tube is rotated the blade may simply pull apart a few pieces of peat without obtaining a complete section. In the case of the usual 5 cm diameter piston sampler, the first few decimetres of undecomposed peat commonly form a plug that prevents further core recovery, and one must often resort to a shovel to obtain the upper peat. The corers described here are equipped with a serated cutting edge, along with modifications to permit the core tube to be rotated back and forth, so that undecomposed fibers and roots can be cut. Complete sections of peat and even the underlying silt or sand several meters deep can be acquired. The wide tube of the 10 cm diameter corer provides sufficient material for close-interval macrofossil and chemical analysis and for radiocarbon dating. The narrower corer is more portable and more convenient. Detailed guides to the operation of piston corers and related devices are described elsewhere (Wright 1983).
W84-04611

THE EROSIVE EFFECTS INDUCED BY BOAT PROPELLERS ON THE BOTTOM AND EMBANKMENTS OF WATERWAYS (EFFETS EROSIFS DES JETS D'HELICE DE BATEAU SUR LES FONDS ET LES TALUS DES VOIES NAVIGABLES),
Laboratoire National d'Hydraulique, Chatou (France).
J. P. Bouchard.
La Houille Blanche, Vol. 7/8, p 485-493, 1983. 4 Fig, 20 Ref.

Descriptors: *Erosion, *Boat propellers, *Bottom sediments, *Embankments, Mathematical equations, Waterways, Bank erosion, Erosion rates.

An analysis of investigations carried out on the effects of propeller jets has made it possible to deduce a general formula which is relatively diagrammatic but enables the diameter of the protective rockfill to be calculated according to the main characteristics of the boat. (Author's abstract)
W84-04651

THE MECHANICS OF MUD EROSION (MECANIQUE DE L'EROSION DES VASES),
Institut de Physique du Globe de Paris (France).
C. Perigaud.
La Houille Blanche, Vol. 7/8, p 501-512, 1983. 9 Fig, 6 Tab, 57 Ref.

Descriptors: *Erosion, *Mud, Mud-water interfaces, Turbulent flow, Unsteady flow, Varied flow, Flow profiles, Flow velocity, Sediments, Physical properties, Soil properties.

Muds react in a rheologically complex manner but these reactions can be diagrammatically summarized using various models. Muds of low concentration have the behavior of non-linear viscous fluids whereas highly concentrated muds exhibit a plastic threshold equivalent to the fracture of a solid. A current which erodes a mud can be simulated by a turbulent horizontal flow in which bursts play a crucial role. They periodically strike the water-mud interface and create stresses, the maximum force of which is well above the stress exerted by the average flow. Muds are eroded beyond a certain flow velocity, the so-called critical erosion velocity. Above this velocity erosion occurs intermittently because it is linked to the action of bursts. Muds of low concentration are eroded in the form of streamtubes which are carried away and then broken up by the flow. In the

case of highly concentrated muds little blocks of sediment are torn away and remain in the flow as small entities once they have been put into suspension again. (Author's abstract)
W84-04652

2K. Chemical Processes

MESOSCALE SPATIAL VARIABILITY OF SULFATE IN AIR AND RAINWATER AT ST. LOUIS,
Newcastle Univ. (Australia). Dept. of Geography.
H. W. Bridgman.
Water, Air, and Soil Pollution, Vol. 22, No. 2, p 153-172, 1984. 10 Fig, 1 Tab, 18 Ref. Department of Energy contract DE-AC02-76EV01199.

Descriptors: *Sulfate, *Rainwater, *Spatial variability, Water pollution sources, Chemistry of precipitation, Air pollution, Air pollution effects, St. Louis.

Sulfate concentrations in rainwater and in air measured on four summer days at St. Louis were highly variable, both spatially or temporally. Maximum/minimum ratios of aerosol SO4(2-) varied by up to a factor of 9, and those in rainwater by a factor of 3 on the average. Generally, SO4(2-) concentration patterns in air and rainwater were similar, and consistent with wind direction and the location of sources. Direct relationships between SO4(2-) in air and in water were evident on two of the individual days, but not for all days together. The non-uniformity of the SO4(2-) pattern plus consideration of possible sources of SO4(2-) suggests that nucleation of SO4(2-) particles must be a major cause of S scavenging, with some possible influence from sub-cloud impaction. (Author's abstract)
W84-04210

PRELIMINARY PLASMA SPECTROMETRIC ANALYSES FOR SELECTED ELEMENTS IN SOME GEOTHERMAL WATERS FROM CERRO PRIETO, MEXICO,
Geological Survey, Menlo Park, CA. Water Resources Div.
J. W. Ball, and E. A. Jenne.
Available from the Ofss, USGS, Lakewood, CO 90225, Price: $1.50 paper copy, $3.50 microfiche. USGS Water Resources Investigations Report 83-4056, 1983. 9 p, 4 Tab, 2 Ref.

Descriptors: *Geothermal studies, *Trace metals, *Emission spectroscopy, Geothermal resources, Effluents, Metals, *Mexico, Cerro Prieto, Multielement analysis, Spectral interferences.

As part of a cooperative study with Dr. Alfred Truesdell, water samples collected from geothermal power production wells at Cerro Prieto, Mexico, were analyzed for selected elements by d.c. argon plasma emission spectroscopy. Spectral interferences due to the presence of high concentrations of Ca, Si, Na and K in these water affected the apparent concentration values obtained. These effects were evaluated and correction techniques were developed and applied to the analytical values. Precipitates present in the samples at the time of analysis adversely affected the accuracy, precision and interpretability of the data. (USGS)
W84-04263

RADIUM AND BARIUM IN THE AMAZON RIVER SYSTEM,
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences.
W. S. Moore, and J. M. Edmond.
Journal of Geophysical Research, Vol. 89, No. C2, p 2061-2065, March 20, 1984. 3 Fig, 2 Tab, 14 Ref.

Descriptors: *Rivers, *Chemical reactions, *Radium, *Barium, *Amazon River, Weathering, Fractionation, Uranium, Thorium, Model studies, Radioisotopes.

The isotopes of radium exist in natural waters largely unsupported by decay of their immediate parents in solution. Continuous production and release of radium isotopes from their long-lived parents in solid phases supports the activities measured in the aqueous phase. Thus, the relative abundance of Ra isotopes in rivers should be an index of the distribution of U and Th in solid phases in the drainage basin. Fundamental data is provided on the radium isotope content of the largest river in the world, the Amazon, as well as its tributaries. These data enable estimates to be made of the dissolved fluxes of Ra-226 and Ra-228 to the ocean and to investigate possible fractionation of U and Th in the Amazon basin. Based on the Ra isotope content of the rivers and the Ra/Ba ratios, it is concluded that little fractionation of U and Th has occurred within the basin during weathering. The Ra-226 data fit a flux model for the major ions indicating that Ra-226 behaves conservatively along the main channel of the Amazon River. (Baker-IVI)
W84-04296

THE CHEMISTRY OF THE SEVERN ESTUARY AND THE BRISTOL CHANNEL,
Institute for Marine Environmental Research, Plymouth (England).
For primary bibliographic entry see Field 2L.
W84-04335

TIME-VARIANT DIFFERENCES IN CHEMISTRY AMONG FOUR SMALL STREAMS,
For primary bibliographic entry see Field 2H.
W84-04359

DISSOLVED INORGANIC SUBSTANCES, A STUDY OF MASS BALANCE IN THREE SMALL DRAINAGE BASINS,
Uppsala Univ. (Sweden). Dept. of Hydrology.
U. M. Calles.
Hydrobiologia, Vol. 101, No. 1/2, p 13-18, April, 1983. 3 Fig, 2 Tab, 12 Ref.

Descriptors: *Dissolved inorganic matter, *Dissoved solids, Chemical properties, Deposition, Salinity, Catchment areas, Velen basin, Kassjoan basin, Lapptrasket basin.

During the International Hydrological Decade (IHD) three drainage basins were selected as being representative for Swedish forest areas. These basins were Velen, Kassjoan and Lapptrasket. Although the Representative Basin Project ended in 1975 investigations have been continued in some of the sub-basins. This paper is based on data from three sub-basins within Lapptrasket and Kassjoan. Investigations were carried out on chemical composition of runoff and precipitation in order to compute the balance of analyzed ions. Annual transports were computed using one analysis per month and monthly mean discharge of water. Since the chloride content of the bedrock is very low all the discharged chloride is regarded as being of atmospheric origin. This assumption has been used for the calculation of balance. Computed balances show a deposition of sulphur that exceeds the amount of sulfur discharges. Cations show a discharge that exceeds deposition in all investigated basins. (Author's abstract)
W84-04696

COMPLEXATION OF COPPER BY AQUATIC HUMIC SUBSTANCES FROM DIFFERENT ENVIRONMENTS,
Geological Survey, Denver, CO.
D. M. McKnight, G. L. Feder, E. M. Thurman, R. L. Wershaw, and J. C. Westall.
The Science of the Total Environment, Vol. 28, p 65-76, June, 1983. 1 Fig, 4 Tab, 17 Ref.

Descriptors: *Humic substances, *Copper, *Complexation, Computers, Organic carbon, Chemical speciation, Bioavailability, Equilibrium constant, Path of pollutants, Natural waters.

The copper-complexing properties of aquatic humic substances isolated from eighteen different environments were characterized by potentiometric titration, using a cupric ion selective electrode. Potentiometric data were analyzed using FITEQL, a computer program for the determination of chemical equilibrium constants from experimental data. All the aquatic humic substances could be modelled as having two types of Cu(II)-binding sites: one with K equal to about 1,000,000 and a concentration of 1.0 + or - 0.4 x 10 to the -6th M/(mg C) and another with K equal to about 10 to the 8th and a concentration of 2.6 + or - 1.6 x 10 to the -7th M/(mg C). A method is described for estimating the Cu(II)-binding sites associated with dissolved humic substances in natural water based on a measurement of dissolved organic carbon, which may be helpful in evaluating chemical processes controlling speciation of Cu and bioavailability of Cu to aquatic organisms. (Author's abstract)
W84-04740

QUANTITATION OF METAL COMPLEXES BY REVERSE-PULSE AMPEROMETRY AND MOLECULAR-EXCLUSION CHROMATOGRAPHY,
North Dakota Univ., Grand Forks. Dept. of Chemistry.
M. L. Adamic, and D. E. Bartak.
Analytica Chimica Acta, Vol. 158, No. 1, p 43-55, April, 1984. 6 Fig, 1 Tab, 30 Ref, OWRT grant B-057-NDAK.

Descriptors: *Metal complexes, *Complexing agents, Amperometry, Chromatography, Trace metals, Binding agents, Copper, Fulvic acids, EDTA, Trace metals.

Quantifying metal-binding or complexing agents in aqueous environments is important, since the binding agents will affect the chemical speciation of trace metals, which ultimately determines the reactivity, transport, and biological availability of the metal. Two important factors which should be known are the nature of the binding agent and the binding agent concentration. An electrochemical flow cell in conjunction with modified molecular-exclusion chromatographic techniques is used to identify and quantify a series of copper complexes. A reverse-pulse amperometric mode is used to quantify the complexes and to minimize oxygen interference. The chromatographic eluent is modified by 'buffering' with copper(II) to prevent dissociation of labile complexes. A Sephadex G-25 column resolves a mixture of copper complexes of polyaminocarboxylic acids. A detection limit of 0.65 micro g was obtained for the Cu-EDTA complex. Copper(II)-citrate complexes were well resolved on the Sephadex column as a dimeric complex with a detection limit of 1.0 micro g. Fulvic acid complexes of copper were quantified with the above techniques upon elution from a Sephadex G-15 column. A detection limit of 5 micro g was found for a copper-fulvic acid complex. EDTA can be quantified in the presence of fulvic acid by these techniques. The technique is potentially useful in the determination of complexation capacities in water systems. (Moore-IVI)
W84-04770

2L. Estuaries

HYDRODYNAMICS OF THE BRISTOL CHANNEL,
Institute for Marine Environmental Research, Plymouth (England).
R. J. Uncles.
Marine Pollution Bulletin, Vol. 15, No. 2, p 47-53, February, 1983. 8 Fig, 40 Ref.

Descriptors: *Channels, *Hydrodynamics, *Bristol Channel, *England, Fluid mechanics, Tidewaters, Tides, Water currents, Tidal currents, Vertical flow, Salinity.

The most obvious feature of the circulation in the Bristol Channel is the oscillatory tidal current. Indeed the tides were involved in the earliest attempts to describe circulation within the Channel. Much of the more recent work has been concerned with the possible effects of a barrage on the tidal regime. Both tidal and residual currents are used to review what is known of the effects of tidal stress on the sea bed, and on vertical mixing, as well as discerning their effects on dispersion of salt and other solutes. Tides in the Bristol Channel are predominantly semidiurnal with the largest compo-

nent being the principal lunar tide. Tidal and residual currents produce a frictional drag on the sea bed (tidal stress). Large tidal stresses are associated with strong vertical current shear which generates intense vertical mixing. By fitting logarithmic or Van Veen profiles of velocity to observed maximum flood and ebb currents, the vertical eddy viscosity can be estimated. A time-scale for the vertical mixing of a passive tracer released at the surface can be derived by assuming that the vertical eddy diffusivity and viscosity are equal in the homogeneous water of the Channel. Salinity computed from a coarse-grid, two-dimensional model and observed salinity are compared over several years for six large regions. The agreement between observed and predicted salinity is reasonable. (Baker-IVI)
W84-04333

SEDIMENTATION PROCESSES IN THE BRISTOL CHANNEL/SEVERN ESTUARY,
Institute of Oceanographic Sciences, Taunton (England).
K. R. Dyer.
Marine Pollution Bulletin, Vol. 15, No. 2, p 53-57, February, 1984. 4 Fig, 29 Ref.

Descriptors: *Estuaries, *Sedimentation, *Sediment transport, *Bristol Channel, *Severn Estuary, *England, Distribution, Fate of pollutants, Tidal effects, Tidal prism.

The Bristol Channel and Severn Estuary together form a wide, shallow estuary with a large tidal range and strong currents. The residual current flow in the Bristol Channel has been modelled using a vertically integrated scheme which indicated a general westerly residual current, with a clockwise circulation in Swansea Bay and west of Nash Point. The sediment distribution and sediment budgets in the Inner Bristol Channel and Severn Estuary are reviewed with discussions on both sandy and muddy sediment and its transport. The system is more or less in balance in the subtidal prism in the estuary above the Holms and any further sediment input would be deposited outside the Holms. The major sediment supply seems to be of fine-grained material from the rivers, but because of the very high tidal energy, the existing sediments are continually being reworked and redistributed. Any major alteration of the topography or the tidal regime would disrupt this regime. Because of the large quantity of fine sediment in motion and its affinity for pollutants it is important to understand the processes by which the high concentrations settle, erode and mix. (Baker-IVI)
W84-04334

THE CHEMISTRY OF THE SEVERN ESTUARY AND THE BRISTOL CHANNEL,
Institute for Marine Environmental Research, Plymouth (England).
A. W. Morris.
Marine Pollution Bulletin, Vol. 15, No. 2, p 57-61, February, 1984. 2 Fig, 33 Ref.

Descriptors: *Estuaries, *Chemical reactions, *Bristol Channel, *Severn Estuary, *England, Oxygen, Nutrients, Temperature effects, Seasonal variations, Metals, Salinity, Particulates.

The occurrence of an oxygen sag in the upper reaches of the Severn Estuary, especially under summer conditions of low flow and high temperature, has not been fully characterized. The waters of the Severn Estuary and Bristol Channel do not constitute a simple two-component mixing gradient between the primary river input and offshore waters. The Severn River supplies only about a quarter of the total freshwater input to the system. Concentrations of some nutrients and metals within the Inner and Outer Severn Estuary are plotted against salinity. Some dissolved constituents do show synoptic linear relationships with salinity within this part of the estuary, either consistently or at certain times. The combination of widely distributed sources, temporal variability in anthropogenic inputs and, especially for the nutrients, seasonal variability in riverine concentrations, coupled with the long estuarine flushing time, severely restricts the use of synoptic distribution of dissolved constituents for qualitative and quantitative deductions concerning chemical behavior within the waters of the Inner and Outer Severn Estuary. The estuary has a very large capacity for assimilating particulate contaminants and this generally obviates the use of particulate compositions and their spatial characteristics for elucidating aspects of chemical reactivity within the Severn Estuary. (Baker-IVI)
W84-04335

THE MICROBIAL ECOLOGY OF THE BRISTOL CHANNEL,
Institute for Marine Environmental Research, Plymouth (England).
I. R. Joint.
Marine Pollution Bulletin, Vol. 15, No. 2, p 62-66, February, 1984. 5 Fig, 17 Ref.

Descriptors: *Ecology, *Microorganisms, *Bristol Channel, *England, Estuarine environment, Estuaries, Phytoplankton, Turbidity, Metals, Iron, Water pollution effects.

Bristol Channel is considered as being divided into 7 geographical regions, some of which have very high suspended solids concentrations. Turbidity varies with tidal state and with season. The shallowness of the euphotic layer has a considerable influence on phytoplankton ecology in the Channel. Recent studies have derived time-scales for vertical mixing and discuss the importance of this process to phytoplankton ecology. Although the phytoplankton of the Channel are light-limited, they are unlikely to be limited by nutrients. The major source of dissolved organic carbon (DOC) to the Channel is riverine. DOC shows a conservative mixing behavior in the Channel and a large proportion must be refractory and is not utilized by heterotrophic microbes. While there was a strong correlation between heterotrophic potential and turbidity, the highest activity did not always occur at times of highest turbidity. The reported levels of zinc and copper in the Channel are greater than those which inhibit photosynthesis. However, it is arguable whether heavy metals are limiting phytoplankton production. The turbidity is so great in many areas that phytoplankton is severely light-limited and heavy metal inhibition may not significantly affect the already limited photosynthesis. (Baker-IIV)
W84-04336

THE BENTHIC ECOLOGY OF THE BRISTOL CHANNEL,
Institute for Marine Environmental Research, Plymouth (England).
R. M. Warwick.
Marine Pollution Bulletin, Vol. 15, No. 2, p 70-76, February, 1984. 7 Fig, 1 Tab, 21 Ref.

Descriptors: *Benthic environment, *Bristol Channel, *England, *Benthos, Population dynamics, Tidal effects, Fauna, Distribution, Simulation, Tidal effects, Currents.

The factors underlying the distribution, structure and functioning of benthic communities and the interactions between the benthos and other components of the ecosystem were examined in the Bristol Channel. Samples of the bottom fauna were taken on a grid of 155 stations in the Channel from Lundy Island to just above the Holme Islands. The inner part of the Channel is a zone of erosion with a rock bed. In the eastern Bristol Channel, the bed types of Bridgwater Bay and the lower Severn estuary are governed by extremely dense suspensions of particulate material maintained in the water column by the strong tidal currents. The influence of high current speeds and the associated stress on the sea bed result in a reduced hard-bottom fauna in the upper part of the channel. Each community subdivision found in the Channel has its center of distribution at a particular bed stress value. These relationships were used to compile an idealized simulation of the distribution of faunal types on the assumption that they relate directly to tidal stess, with no overlap between. At present the observed properties of community structure and function are explicable in terms of natural forcing functions, of which current speed is the most important, rather than resulting from pollution of the water. (Baker-IVI)
W84-04337

LEAD CYCLING IN ESTUARIES, ILLUSTRATED BY THE GIRONDE ESTUARY, FRANCE,
Ecole Normale Superieure, Paris (France). Lab. de Geologie.
For primary bibliographic entry see Field 5B.
W84-04338

VARIABILITY AND FLUXES OF NITROGEN AND ORGANIC CARBON AT THE MOUTH OF A COASTAL LAGOON,
Centro de Investigacion Cientifica y de Educacion Superior de Ensenada (Mexico). Div. of Oceanology.
B. C. Farfan, and S. Alvarez-Borrego.
Estuarine, Coastal and Shelf Science, Vol. 17, No. 6, p 599-612, December, 1983. 4 Fig, 2 Tab, 35 Ref.

Descriptors: *Coastal lagoons, *Nitrogen, *Organic carbon, *San Quentin Bay, *Mexico, *Tidal effects, Heat, Nutrients, Productivity, Detritus, Upwelling, Dinoflagellates, Zooplankton, Seagrass.

This work examines the tidal exchanges of heat, inorganic nitrogenous nutrients and various forms of organic matter at the mouth of San Quentin Bay, Baja California, Mexico. It also attempts to elucidate the main factors responsible for the short-term fluctuations of these seawater properties. To accomplish this, a time series sampling was carried out at the mouth of the bay from 25 June to 5 July, 1979. The bay systematically exported heat, with an average of 1.2 x 10 to the 10th kcal per half tidal cycle during the sampling period. Inputs of nitrite and nitrate during upwelling were of major importance to the productivity of the lagoon. During non-upwelling conditions the trend was toward a dynamic equilibrium in the oxidized inorganic nutrient fluxes. There were significant exports of ammonia. These ammonia exports were, on average, about 20% of the nitrate plus nitrate imports. Ammonia concentrations were related to metabolic and mixing processes. Ammonia might be an important export product throughout the year, as a result of the reduced state of the sediments. During the sampling, there were imports of particulate organic carbon and nitrogen. The C/N ratio suggests that the main origin detritus was other than the breakdown of eelgrass in the bay. There were mostly imports of diatom carbon, but fluxes of dinoflagellate carbon were always near equilibrium. Zooplankton showed both exports and imports. Variability in the zooplankton carbon was mostly related to diel vertical migration. There were no significant exports of floating seagrass, not even during spring tides. (Author's abstract)
W84-04366

NUTRIENT FLUX IN THE RHODE RIVER: TIDAL EXCHANGE OF NUTRIENTS BY BRACKISH MARSHES,
Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies.
T. E. Jordan, D. L. Correll, and D. F. Whigham.
Estuarine, Coastal and Shelf Science, Vol. 17, No. 6, p 651-667, December, 1983. 5 Fig, 7 Tab, 38 Ref. NSF grant DEB 7911563.

Descriptors: *Nutrient cycling, *Tidal effects, *Brackish marshes, *Rhode River, *Maryland, Nitrogen, Phosphorus, Organic carbon, Bulk precipitation, Mudflats, Estuarine environment, Particulates.

Tidal exchange of nitrogen, phosphorus, and organic carbon by a high and a low elevation marsh in the Rhode River estuary were measured throughout the year. Both marshes tended to import particulate matter and export dissolved matter, although they differed in the fluxes of certain nutrients. Compared with tidal exchanges, bulk precipitation was a major source of ammonia and nitrate and a minor source of other nutrients. There was a net retention of nutrients by the portion of the Rhode River that included both

marshes and a mudflat. However, the marshes accounted for only 10% of the phosphorus retention and 1% of the nitrogen retention while they released organic carbon amounting to 20% of the retention. This suggests that the mudflat acted as a sink for nutrients. The primary role of the marshes seems to be transformation of particulate to dissolved nutrients rather than nutrient retention or release. (Author's abstract)
W84-04367

NUTRIENT FLUX IN THE RHODE RIVER: TIDAL TRANSPORT OF MICROORGANISMS IN BRACKISH MARSHES,
Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies.
P. A. Rublee, S. M. Merkel, and M. A. Faust.
Estuarine, Coastal and Shelf Science, Vol. 17, No. 6, p 669-680, December, 1983. 4 Fig, 3 Tab, 42 Ref. NSF grant DEB 7911563.

Descriptors: *Tidal effects, *Brackish marshes, *Microorganisms, *Rhode River, *Maryland, *Nutrients, Bacteria, Chlorophyll a, Organic compounds, Estuarine environment.

Concentrations of bacteria, chlorophyll a, and several dissolved organic compounds were determined during 11 tidal cycles throughout the year in a high and a low elevation marsh of a brackish tidal estuary. Mean bacterial concentrations were slightly higher in flooding (7,100,000 cells/ml) than in ebbing waters (6,500,000 cells/ml), and there were no differences between marshes. Mean chlorophyll a concentrations were 36.7 microg/l in the low marsh and 20.4 microg/l in the high marsh. Flux calculations, based on tidal records and measured concentrations, suggested a small net import of bacterial and algal biomass into both marshes. Over the course of individual tidal cycles, concentrations of all parameters were variable and not related to tidal stage. Heterotrophic activity measured by the uptake of H-3-thymidine, was found predominantly in the smaliest particle size fractions (less than 1.0 um). Thymidine uptake was correlated with temperature (r=0.48, P less than 0.01), and bacterial productivity was estimated to be 7 to 42 microg C/l/day. (Author's abstract)
W84-04368

NATURAL ISOTOFIC COMPOSITION OF NITROGEN AS A TRACER OF ORIGIN FOR SUSPENDED ORGANIC MATTER IN THE SCHELDT ESTUARY,
Paris-6 Univ. (France). Lab. de Geophysique Appliquee.
A. Mariotti, C. Lancelot, and G. Billen.
Geochimica et Cosmochimica Acta, Vol. 48, No. 3, p 549-555, March, 1984. 8 Fig, 3 Tab, 31 Ref.

Descriptors: *Isotope studies, *Suspended sediments, *Estuaries, Estuarine environment, Scheldt estuary, Nitrogen, Ammonia, Nitrification, Phytoplankton, Seasonal variation, North Sea, Seas.

The natural isotopic composition of suspended particulate organic nitrogen was determined in the Southern Bight of the North Sea and in the Scheldt estuary, and proved to be a useful tracer to determine origin of suspended organic matter. The data presented show the very important seasonal variability of the isotopic composition of suspended nitrogen and the complexity of the interrelated processes controlling them. In the winter, in the absence of intensive primary production, the suspended organic matter was a mixture of two components: a continental detrital component and a marine component. During the phytoplankton flowering period intensive primary production occurred throughout the estuary giving rise to a third source of organic matter. Simple isotopic budget calculations show that, both in the upstream part and in the downstream part, autochthonous phytoplanktonic material contributes a major part of the total suspended matter in the Scheldt estuary during summer. (Baker-IVI)
W84-04380

THE EFFECT OF MACROPHYTE REMOVAL ON THE DISTRIBUTION OF SELECTED INVERTEBRATES IN A LITTORAL ENVIRONMENT,
Idaho Univ., Moscow. Dept. of Biological Sciences.
F. W. Rabe, and F. Gibson.
Journal of Freshwater Ecology, Vol. 2, No. 4, p 359-371, April, 1984. 3 Fig, 5 Tab, 27 Ref.

Descriptors: *Littoral environment, *Macrophytes, *Vegetation effects, Phytoplankton, Habitats, Wetlands, Zooplankton.

Submerged vegetation was removed from four locations in a shallow wetland lake containing a dense concentration of aquatic macrophytes. The distributions of selected species of zooplankton and macroinvertebrates were compared over a two month period between the vegetated sites and locations in which vegetation was removed. A major difference was the relative numbers of Daphnia schodleri and small species of cladocerans. These small microcrustaceans were clearly more abundant than D. schodleri at vegetated sites. Early in the study Daphnia was collected most frequently in deep water. However, later in the season it was sampled most commonly in the shallow sites. The shift of Daphnia to these sites coincided with decreasing plant biomass in the shallow water due to senescence and waterfowl foraging. The small cladocerans showed an opposite shift to deeper water where macrophyte density was greater. Phytoplankton were more dense in vegetated sites than denuded ones and species composition was similar in both. (Baker-IVI)
W84-04384

SALTMARSHES OF THE UPPER FORTH ESTUARY,
J. Proctor, M. W. Fraser, and J. Thompson.
Botanical Society of Edinbourgh Transactions, Vol. 44, Part 2, p 95-102, 1983. 1 Fig, 2 Tab, 14 Ref.

Descriptors: *Estuaries, *Saltmarshes, *Vegetation, *Upper Forth Estuary, *Scotland, Puccinellietum, Juncetum, Marshes, Topography, Salinity.

The extent of the saltmarshes in the Upper Forth has diminished greatly, largely due to land reclamation efforts in the eighteenth and nineteenth centuries and the facts of erosion currently. The vegetation along 15 transects from different marshes is described and classified. One of the quadrants contained no vegetation and the remaining 149 were initially classified by computer using a polythetic divisive method. Although there are some special features, the vegetation is generally poor in species and communities. The majority of the samples fall clearly within the two most common and widespread associations on British saltmarshes: Puccinellietum maritmae or Juncetum gerardi. One of the most likely causes of this poverty is the great disturbance and reduction in area associated with reclamation. Most of the existing saltmarshes occur as a strip 5 to 80 m wide in front of the sea wall. The grazing history of the saltmarshes is unclear. The distribution of the halophytic plants can be related to the salinity of the upper estuary but this is very variable and depends on many factors. (Baker-IVI)
W84-04389

SALINITY AND TEMPERATURE EFFECTS ON PHOTOSYNTHESIS AND ORGANIC CARBON RELEASE RATES BY SELECTED BENTHIC MACROALGAE,
Connecticut Univ., Storrs. Inst. of Water Resources.
C. Yarish, and M. Heller.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-163146, Price codes: A04 in paper copy, A01 in microfiche. Completion Report, September, 1983. 51 p, 4 Fig, 12 Tab, 105 Ref. Project No. OWRT A-091-CONN(1), Contract/Grant No. 14-34-0001-2107.

Descriptors: *Food chains, *Benthic flora, *Algae, Estuarine environment, *Photosynthesis, *Salinity, *Temperature, *Organic carbon, Algal growth water, Radioactivity, Water pollution effects.

Estuarine benthic macroalgae are excellent producers of new carbonaceous material through their high rates of photosynthesis. Under some circumstances, this organic carbon is liberated into the aquatic environment in dissolved form while the plant is actively photosynthesizing. This project established a protocol for examining the effects of different combinations of salinity, temperature, and emergence/submergence regimes, determined the effects of antibiotics on the photosynthetic rate, and the extent to which these factors effect liberation of organics by selected estuarine benthic macroalgae. In establishing the preoperational procedures, the following determinations were made: 1) To reduce organic carbon background contamination to the lowest possible level, a 1.0h to 1.5h of ultraviolet radiation of the seawater and distilled/deionized water used in the media preparation was needed, 2) A level of 10uCi was required to allow adequate uptake and detection of released products, 3) Since bacterial contamination would mask released organic carbon, antibiotics were included in the media. It was found, however, that even at the lowest level, algal production rates were markedly reduced while the organic carbon release-rates were greater than that observed for the controls, 4) At the level of added radioactivity (10uCi), at least 15 min of bubbling was necessary to achieve acceptable background values. This assay was performed to preclude interference by radioactive inorganic carbon when determining the amount of organic carbon released by the test species, 5) It was found that the level of inorganic C-14 released from an aqueous solution by acidification and bubbling is extremely time dependent.
W84-04407

MICROELEMENTS IN POLDERS OF THE NEMAN RIVER DELTA,
M. M. Ermolayev, and V. E. Ryaboi.
Soviet Soil Science, Vol. 15, No. 2, p 63-69, 1983. 3 Tab, 11 Ref. Translated from Pochvovedeniye, No. 2, p 49-55, 1983.

Descriptors: *Polders, *Deltas, *Chemical analysis, *Neman River, *USSR, Trace elements, Groundwater, Meadows, Peat bogs, Soil types.

Data are presented concerning the content of microelements in parent rocks, meadow coenoses and soil ground waters in the polders of the Neman river delta. The soil forming rocks of the Neman river delta are characterized by a great diversity of microelement content which is due to lithological heterogeneity of the rocks. The higher concentration of microelements is a characteristic of glaciers and old alluvial clay and loam. The old alluvial and aeolian sands are poor in microelements with the exception of titanium and beryllium. Soil developed on old alluvial depositions has the highest concentration of fluorine, strontium, zinc, cobalt, and copper. Biogenic accumulation of different chemical elements has been observed in peat-bog soils. Cultivated soils contain greater amounts of many different chemical elements than do uncultivated and poorly cultivated soils. In the process of particle differentiation, accumulation of manganese, zinc, cobalt, nickel, copper and chromium occurs in the minute dispersed materials. In sand and coarse dust particle fractions, titanium, barium, and strontium mainly concentrate. The amount of accumulation depends strongly on the soil type, soil horizon and composition of the soil forming rocks. Very low content of cobalt and molybdenum were found which is common for the meadow vegetations of the polders of the Neman river delta. In the soil ground water of old alluvial and peat-bog depositions, relatively high concentrations of manganese, copper, zinc, fluorine, boron and very rare cobalt and nickel have been observed. The two-way regulation of water regime of the polders intensifies copper and zinc removal by the ground water from superaqueous landscapes. (Baker-IVI)
W84-04521

ORGANIC CARBON AND SULFUR IN THE SEDIMENTS OF THE VIRGINIA CHESAPEAKE BAY,

William and Mary Coll., Gloucester Point, VA. Inst. of Marine Science.
C. H. Hobbs, III.
Journal of Sedimentary Petrology, Vol. 53, No. 2, p 383-393, June, 1983. 7 Fig, 1 Tab, 26 Ref. EPA Grant R806001010.

Descriptors: *Sediments, *Chesapeake Bay, *Virginia, Mobjack Bay, Tangier Sound, Hampton Roads, Industrial wastes, Bacteria, Organic carbon, Sulfur, Clay, Chemical reactions.

A strong relationship was determined between the clay content and the organic-carbon and sulfur contents of the sediments of the lower Chesapeake Bay. Organic carbon and sulfur contents of 900 sediment samples from the Virginia portion of the Bay averaged 1.0% and 0.35%, respectively. This relationship is probably a result of the great surface area presented by a large volume of clay particles and of the chemically active nature of the clays. Generally the relationship of organic carbon and sulfur within the sediments is strong, which reflects sulfate reduction by bacteria with organic carbon serving as food for the bacteria. Several subareas of the Bay are affected by different processes which, in turn, influence the sedimentological and chemical relationships. The urban, industrial surroundings of Hampton Roads create an environment quite different from that in Tangier Sound or Mobjack Bay. The volume of fresh-water inflow, the nature of the drainage basin, and the local energy-regime, in the form of waves and currents, all contribute to local variations. (Baker-IVI)
W84-04606

RESPONSE CHARACTERISTICS OF AN EBB-DOMINATED TIDAL INLET CHANNEL,
Boston Univ., MA. Dept. of Geology.
D. M. Fitzgerald, and D. Nummedal.
Journal of Sedimentary Petrology, Vol. 53, No. 3, p 833-845, September, 1983. 10 fig, 5 Tab, 25 Ref. Army Research Office grant DAAG-29-76-6-0111.

Descriptors: *Ebb-tidal inlet channel, *Channels, *Tides, Tidal hydraulics, Tidal basins, Tidal currents, Price Inlet, South Carolina.

A three-year study (July 1974 to 1977) of Price Inlet, South Carolina, monitored inlet hydraulics and channel morphology. The inlet is strongly ebb-dominant. Both the peak and mean current velocities during ebb exceed the corresponding velocities during flood. The velocity asymmetry is caused by changes in inlet efficiency during the tidal cycle. The intertidal marsh of the Price Inlet drainage area experiences a change in open water surface area of about 670 percent during an average tidal cycle. At high tide, the large water surface of the marsh is responsible for inefficient exchange of water through the inlet. This causes a long time lag between ocean and bay tides. The small surface area of open water in the marsh at low tide, on the other hand, yielded nearly no time lag. These differential time lags cause longer flood durations than ebb durations in the inlet throat and consequently, stronger ebb velocities. Monitoring of the cross-sectional flow area of the inlet throat demonstrates rapid adjustment to changing flow conditions. The 1159 sq m cross sectional area of the inlet throat varied as much as 8.3% during one tidal cycle. The cross sectional area varied in phase with the tidal range. Long-term changes in the dimensions of the channel appear to be a direct result of changes in the size of ebb-tidal delta shoals. During the study period, the growth of the linear bars in the channel margin gradually reduced wave energy along the inlet shoreline and on the inner ebb-tidal delta platform. This in turn reduced sediment transport into the inlet, which resulted in a gradual increase in the cross-sectional area of the channel. Seasonal fluctuations in mean sea level appear to have little effect on the inlet channel. (Author's abstract)
W84-04607

SEDIMENT COMPOSITION AND HYDROGRAPHY IN SIX HIGH-GRADIENT ESTUARIES OF THE NORTHWESTERN UNITED STATES,
Oregon State Univ., Corvallis. School of Oceanography.
C. Peterson, K. Scheidegger, P. Komar, and W. Niem.
Journal of Sedimentary Petrology, Vol. 54, No. 1, p 86-97, March, 1984. 6 Fig, 2 Tab, 37 Ref. Department of Commerce project P/CP-3, grant 04-7-158-44-85.

Descriptors: *Sediment composition, *Hydrography, *Estuaries, *Northwest, *United States, Sedimentation, Sediment transport, Particle size, Deposition, Sediment yield.

Small estuaries of the northwestern United States are fed by high-gradient streams which range widely in mean fluvial-discharge rates. Sediment composition in these estuaries differs with grain size and with the relative abundances of river-and beach-derived sand. In order to determine to what degree sediment composition is related to the relative influence of tidal and river flow in these active-margin estuaries, the modern sediment compositions in six Pacific Northwest estuaries were analyzed by standard grain-size and heavy-mineral techniques. The average textural and sand-source compositions are compared and found to be correlated with a hydrographic parameter HR (mean tidal-prism volume: mean fluvial discharge rate x 6 hours) computed for each bay. Both % mud and % beach sand increase as the dimensionless hydrographic ratio (HR) increases. Unusual results in two of the estuaries are attributed to man-made alterations in one estuary and to eolian transport of beach sand into the other estuary. (Author's abstract)
W84-04610

WETLAND IMPACT ASSESSMENT: PROBLEMS UNDER THE CLEAN WATER ACT,
Nelson (R. Wayne) and Associates, Inc., Boulder, CO.
For primary bibliographic entry see Field 6G.
W84-04612

TEMPORAL OCCURRENCE OF ICHTHYOPLANKTON IN RELATION TO HYDROGRAPHIC AND BIOLOGICAL VARIABLES AT A FIXED STATION IN THE ST LAWRENCE ESTUARY,
Quebec Univ., Rimouski. Dept. of Oceanography.
Y. de Lafontaine, M. Sinclair, M. I. El-Sabh, C. Lassus, and R. Fournier.
Estuarine, Coastal and Shelf Science, Vol. 18, No. 1, p 177-190, 1984. 5 Fig, 7 Tab, 54 Ref.

Descriptors: *Ichthyoplankton, *Hydrography, Biological properties, St. Lawrence estuary, Temporal distribution, Spatial distribution, Hydrologic aspects, Tidal hydraulics, Tides.

Spring to autumn temporal distributions of ichthyoplankton and other oceanographic variables were measured at three nearshore stations in the lower St Lawrence Estuary in 1977 and 1978. The seasonal occurrence of various species of fish eggs and larvae was similar from one year to the next. Inshore-offshore gradients in abundance of eggs and larvae of different species appeared to be primarily related to the spawning location of each species. The semidiurnal variability was considerably less than the week-to-week variability in all physical and biological variables measured. The weekly variability is predominantly a function of spatiotemporal interactions, due to the geographic displacement of different water masses and their associated plankton in relation to the neap-spring tidal cycle. The timing and duration of spawning for each common species, inferred from ichthyoplankton distributions, suggest a unique combination of spawning and hatching times, ensuring a succession in the occurrence of larvae through time. Results of the temporal and spatial distributions of the different species of ichthyoplankton are discussed in terms of reduced competitive interactions. The relationship between ichthyoplankton distributions and the plankton production cycle in the St Lawrence Estuary is discussed in comparison with other areas. (Author's abstract)
W84-04633

BENTHIC NUTRIENT REGENERATION IN SOUTH TEXAS COASTAL WATERS,
Texas Univ. at Austin, Port Aransas. Marine Science Inst.
R. W. Flint, and D. Kamykowski.
Estuarine, Coastal and Shelf Science, Vol. 18, No. 2, p 221-230, February, 1984. 4 Fig, 2 Tab, 31 Ref. Bureau of Land Management contract AA551-CT8-51.

Descriptors: *Benthic environment, *Cycling nutrients, *Texas, *Coastal waters, Nutrients, Phytoplankton, Mud-water interfaces, Benthic fauna, Nutrient removal, Primary production.

Because of the unpredictable nature of many potential nutrient sources for coastal phytoplankton primary production needs in the north-western Gulf of Mexico, benthic regeneration was investigated as a more constant source of nutrients to this ecosystem. Water column ammonia profiles taken at several locations on the south Texas inner-shelf in the last seven years showed peak concentrations in bottom waters. Benthic chamber measurements verified the presence of ammonia fluxes at the mud-water interface in south Texas coastal waters. These fluxes were related to benthic faunal activity as measured by sediment metabolism. Laboratory experiments, designed to test the effect of benthic faunal removal on nutrient regeneration, suggested that the fauna play a role in regulating this process. How this regulation may occur is discussed. Estimated annual benthic regeneration rates can supply 69% of the nitrogen required to support phytoplankton primary production in these coastal waters. (Murphy-IVI)
W84-04634

THE EFFECT OF CHRONIC OIL POLLUTION ON SALT-MARSH NITROGEN FIXATION (ACETYLENE REDUCTION),
William and Mary Coll., Gloucester Point, VA. Inst. of Marine Science.
A. D. Thomson, and K. L. Webb.
Estuaries, Vol. 7, No. 1, p 2-11, March, 1984. 2 Fig, 5 Tab, 39 Ref.

Descriptors: *Oil pollution, *Salt Marshes, *Nitrogen fixation, Acetylene, Virginia, Sediments, Bioaccumulation, Environmental effects, Nitrogen.

Annual acetylene reduction rates associated with intertidal communities in a chronically oil polluted Virginia salt marsh were compared to rates measured in an undisturbed marsh. Chronic oil treatment resulted in visible damage to the higher plants of the Spartina alterniflora zones; however, vegetation-associated acetylene reduction was not different from the untreated control. Sediment rates generally were affected little by oil application, except during the summer when rates in the median tidal elevation zones were considerably higher than those of the control. Acetylene reduction occurred in all transects, each of which extended from upper mudflat to the Spartina patens zone. Intertidal sediment acetylene reduction was patchy, both spatially and seasonally. Estimated rates were greater near the surface; free-living bacterial N2 fixation activity averaged 2.23 mg N per sq m per d (range = undetectable to 365 mg N per sq m per d) in the untreated and 3.17 mg N per sq m per d (range = undetectable to 564 mg N per sq m per d) in the oil-treated marsh during the year. Vegetation-associated N2 fixation activity yielded highest overall mean rates (156 mg N per sq m per d). The seasonal pattern of sediment and vegetation-associated fixation may be controlled by temperature and availability of oxidizable substrates. (Author's abstract)
W84-04669

EFFECTS OF DREDGING AND OPEN-WATER DISPOSAL ON BENTHIC MACROINVERTEBRATES IN A SOUTH CAROLINA ESTUARY,
South Carolina Wildlife and Marine Resources Dept., Charleston. Marine Resources Research Inst.
For primary bibliographic entry see Field 5C.
W84-04670

THE ESTUARINE CHARACTER OF THE GULF OF NICOYA, AN EMBAYMENT ON THE PACIFIC COAST OF CENTRAL AMERICA,
Woods Hole Oceanographic Institution, MA.
A. D. Voorhis, C. E. Epifanio, D. Maurer, A. I. Dittel, and J. A. Vargas.
Hydrobiologia, Vol. 99, No. 3, p 225-237, March, 1983. 11 Fig, 2 Tab, 10 Ref.

Descriptors: *Estuaries, *Gulf of Nicoya, *Pacific Coast, *Central America, Costa Rica, Temperature, Salinity, Tidal hydraulics, Tides, Mixing, Hydrography.

Hydrography and exchange processes in a tropical estuary, the Gulf of Nicoya, Costa Rica, are described from data collected in 1979 and 1980. The measurements and analyses were made in both the dry season and wet season and include temperature, salinity, and density at twenty locations in the gulf and currents (over a semi-diurnal tidal cycle) at five locations. These new results enlarge on the early study by Peterson. Circulation in the lower gulf shows a marked east-west asymmetry due to the predominant runoff along its eastern shore from Rio Barranca and Tarcoles. The freshened surface water from the upper gulf combines with the runoff from these rivers and flows southward along the eastern side of the lower gulf. This flow is compensated by a northward flow of more saline water on the western side at all depths and on the eastern side along the bottom. The boundary between the southward and northward surface flow is marked by a strong salinity front in the rainy season. There is a rapid increase in tidal energy density toward the shoaling northern reaches of the lower gulf, between San Lucas Island and Puntarenas Peninsula. Enhanced mixing must accompany this increase, and direct measurements in the constriction between San Lucas and Puntaneras show that tidal mixing is dominant in transporting salt into the upper gulf against the freshwater runoff. (Author's abstract)
W84-04683

SEASONAL CHANGES IN NUTRIENTS AND DISSOLVED OXYGEN IN THE GULF OF NICOYA, A TROPICAL ESTUARY ON THE PACIFIC COAST OF CENTRAL AMERICA,
Delaware Univ., Lewes. Coll. of Marine Studies.
C. E. Epifanio, D. Maurer, and A. I. Dittel.
Hydrobiologia, Vol. 101, No. 3, p 231-238, May, 1983. 3 Fig, 4 Tab, 24 Ref.

Descriptors: *Seasonal variation, *Nutrients, *Dissolved oxygen, *Gulf of Nicoya, *Tropical regions, *Estuaries, *Central America, Ammonium, Nitrite, Nitrate, Inorganic phosphate, Chemical properties, Water circulation.

Concentrations of ammonium, nitrite, nitrate, inorganic phosphate, and dissolved oxygen were measured at 15 stations in the Gulf of Nicoya during rainy and dry seasons. Results allowed division of the gulf into three areas. The upper gulf is an area greatly affected by changes in rainfall as levels of nutrients varied by an order of magnitude seasonally. The lower gulf shows less seasonal variation and is characterized by low concentrations of nutrients and high concentrations of oxygen at the surface and high concentrations of nutrients and low concentrations of oxygen at the bottom. Nutrient-rich bottom water in the lower gulf appears to be entrained from offshore by the positive estuarine character of the gulf. This process is facilitated by the extremely narrow shelf along the Pacific coast of Costa Rica. These oceanic waters are mixed vertically in the mid-gulf region and carried into the upper gulf by estuarine circulation. (Author's abstract)
W84-04714

HYDRAULIC FACTORS AND PHYTOPLANKTON IN THE BAIE DE MORLAIX (WESTERN ENGLISH CHANNEL) (FACTEURS HYDROLOGIQUES ET PHYTOPLANCTON EN BAIE DE MORLAIX (MANCHE OCCIDENTALE),
Centre d'Etudes d'Oceanographie et de Biologie Marine, Roscoff (France).
V. Martin-Jezequel.
Hydrobiologia, Vol. 102, No. 2, p 131-143, June, 1983. 11 Fig, 1 Tab, 58 Ref.

Descriptors: *Hydrology, Phytoplankton, *English Channel, Physical properties, Chemical properties, Biological properties, Cycling nutrients, Seawater.

Phytoplankton in Roscoff waters (Western English Channel) was studied in spring and summer of 1979 and 1980, parallel to seasonal changes in physical, chemical and biological variables. Strong tides prevent the formation of a seasonal thermocline and the water column remains well mixed throughout the year. Seasonal changes in temperature and salinity show a continuous increase from April to August-September. Dissolved oxygen, dissolved mineral and organic nitrogen and phosphorus vary in relation to phytoplankton production. Silicate shows a seasonal cycle, but is not completely depleted in the sea-water. A decrease of ammonia during the phytoplankton blooms in 1980 suggests that ammonia plays an important role as a nitrogen source. The NO3/PO4 ratio indicates that the sea-water is heavily loaded with nitrate, and shows peak values during phytoplankton blooms, due to a fall in the concentration of phosphate, which may become a limiting nutrient. However, this effect may be offset by a rapid recycling of this nutrient. Chlorophyll a and potential primary production show significant variations. The major blooms are observed in June during both years. The mean production/chl. a ratio is around 6 in both years. Phytoplankton development is marked by the succession of three major groups, during the spring-summer blooms: Thalassiosira spp, Rhizosolenia spp and Chaetoceros spp. The regularity in phytoplankton species succession over a number of years suggest that the species concerned are autochtonous and well adapted to their environment. (Author's abstract)
W84-04721

THE ROLE OF TIDES IN REMOVING PHOSPHORUS FROM LAKE NAKANOUMI, A COASTAL LAGOON IN JAPAN,
Tokyo Univ. (Japan). Biochemical Engineering Lab.
H. Ohtake, S. Kato, and Y. Date.
Archive fur Hydrobiologie, Vol. 99, No. 4, p 443-462, 1984. 11 Fig, 7 Tab, 9 Ref.

Descriptors: *Lake Nakanoumi, *Japan, *Lagoons, *Tidal effects, *Phosphorus, Land reclamation, Brackish water, Sediments.

Lake Nakanoumi is a shallow coastal lagoon which is connected to the Japan Sea only by a narrow channel. Over the past decade the Nakanoumi Land Reclamation and Freshening Project has been in progress to reclaim a total of 28 sq km of agricultural lands and to convert the remaining water basin into a freshwater basin by damming the narrow entrance. Without a detailed knowledge of the tidal phenomena, it appears unwise to cut off the lagoon from the open sea. The role of tides in removing phosphorus from Lake Nakanoumi was investigated. Measurements of inflow and outflow of phosphorus were made at the Nakaura sluice-gate across the entrance channel during the warmer months from April to November in 1981. The net export of phosphorus from Lake Nakanoumi was about 116 tons (14.5 tons/month). Of this, about 40-60% was flushed away by tidal currents. The phosphorus budget showed that the tidal flushing precluded the accumulation of phosphorus due to release from bottom sediment during the warmer months. Tidal flushing is an important pollutant-removal mechanism in this shallow brackish water environment. (Moore-IVI)
W84-04753

WATER UPTAKE BY ROOTS CONTROLS WATER TABLE MOVEMENT AND SEDIMENT OXIDATION IN SHORT SPARTINA MARSH,
Woods Hole Oceanographic Institution, MA. Dept. of Biology.
J. W. H. Dacey, and B. L. Howes.
Science, Vol. 224, No. 4648, 4 May, 1983. 2 Fig, 18 Ref.

Descriptors: *Water uptake, *Plants, *Water table, *Marshes, *Spartina, Oxidation, Sediments, Sediment oxidation, Roots, Grasses, Marsh grass, Nutrients.

Downward movement of the water table during both day and night in the short grass zone of intertidal salt marshes is due not to drainage but to water uptake by roots. Removal of water from the sediment resulted in the entry of air into the sediment, suggesting a feedback between plant growth, water uptake, and sediment oxidation. The water balance of Spartina alterniflora appears to influence the internal morphology of its roots, potentially giving rise to a new mechanism for the mass flow of gas in plants. Aside from the physiological aspects of this study, the observations have profound implications for the interpretation of the biogeochemistry of short S. alterniflora marshes and probably tidal marshes in general. For example, it has long been held that marshes import nutrients and export organic matter to the estuaries and ocean. However, most of the productivity of this ecosystem goes into below ground biomass, which can only be exported in dissolved form, either as dissolved organic carbon or reduced sulfur compounds. The observation of negligible pore-water drainage in the short Spartina zone implies that very little export of dissolved compounds is possible from this part of the marsh. (Baker-IVI)
W84-04767

ARTIFICIAL DIFFUSION IN THE NUMERICAL MODELLING OF THE ADVECTIVE TRANSPORT OF SALINITY,
Institute of Oceanographic Sciences, Birkenhead (England).
A. Owen.
Applied Mathematical Modelling, Vol. 8, No. 2, p 116-120, April, 1984. 8 Fig, 10 Ref.

Descriptors: *Salinity, *Estuaries, *Coastal waters, Mathematical models, Diffusion, Advection, Upstream, Forward time centered space.

The numerical modelling of the transport of salinity in coastal and estuarine regions using upstream finite differences, is considered. Salinity distribution is determined by two distinct physical processes, advection and diffusion. Diffusion is independent of the direction of the fluid flow and can be accurately represented using centered differences. Advection is dependent on the direction of the fluid flow and can be represented using either upstream (US) differences or forward time centered space (FTCS) differences. The artificial diffusion associated with US differences can be incorporated into the physical diffusion in a simple quantitative manner. US differences have the advantage of being transportive, which ensures that they preserve positive definite quantities such as salinity. FTCS differences are not transportive and can give rise to negative salinities and boundary problems. The method presented is always applicable when the artificial diffusion is less than that required physically. Even when this criterion is not satisfied, the US method (with no physical diffusive term) may be preferable to the FTCS method. The method is applicable to finite-difference grids of less than about 2-4 km in tidal problems. For non-tidal problems the method is applicable to larger grids. (Moore-IVI)
W84-04769

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

ARAB POTASH SOLAR EVAPORATION SYSTEM: DESIGN AND DEVELOPMENT OF A NOVEL MEMBRANE CUT-OFF WALL,
G. J. Brice, and J. C. Woodward.
Proceedings of the Institution of Civil Engineers, Vol. 76, p 185-205, February, 1984. 17 Fig, 4 Tab, 4 Ref.

Descriptors: *Potash solar evaporation, *Design criteria, *Membranes, Seepage control, Seepage loss, Seepage, Brines, Permeability, Jordan.

Seepage control was required under a 15 km length of the dikes which form the solar evaporation pans for the Arab Potash project in Jordan. Alternative means of seepage control through the previous rock salt foundations were studied and a novel solution using a membrane cut-off wall was developed. The cut-off involved a 7 m deep excavation of a narrow trench by chain cutter, the development of a self-setting mud which would perform in the very saline conditions, and the use of a semi-rigid polyethylene membrane. This Paper describes the design and development of the membrane cut-off wall, including details of the site conditions, laboratory testing and site trials. (Author's abstract)
W84-04202

SURGE PROTECTION OF WATER SUPPLY PIPELINES FOR JUBAIL INDUSTRIAL CITY,
For primary bibliographic entry see Field 8A.
W84-04204

AGRICULTURAL WASTE WATER - REVERSE OSMOSIS PRETREATMENT,
California State Dept. of Water Resources, Firebaugh.
For primary bibliographic entry see Field 3C.
W84-04232

MASS TRANSFER AND THERMODYNAMIC STUDIES OF EVAPORATIVE FREEZING OF WATER,
Delaware Univ., Newark. Dept. of Chemical Engineering.
L. Pigford.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-153501, Price codes: A03 in paper copy, A01 in microfiche. Completion Report, June, 1983. 17 p, 16 Fig, 1 Tab, 4 Ref. Project No. OWRT C-80280-S (8527) (1), Contract/Grant No. 14-34-001-8527.

Descriptors: *Mass transfer, AFVC process, absorption, Salt water, *Thermodynamic properties, *Freezing, Evaporative freezing, Water treatment, Vapor compression, Solvents.

Some of the key technical problems inherent in the design of equipment for the absorption, freezing, vapor-compression process for the production of pure water from salt water were investigated in laboratory studies. These included the comparison of various solvents for water vapor in the freezer-absorber unit, the determination of water mass transfer rates into concentrated salt solution in the refrigerated absorber, and the measurement of mass transfer coefficients for the absorption of water into a solvent stream that flows over horizontal tubes. The results showed that changes of the solvent can have only a small effect on the power required, that the resistance to heat transfer in the absorber has a greater effect than the resistance to mass transfer. Accumulation of air in the absorber vapor can be important.
W84-04235

APPLIED SIMILARITY CRITERIA IN THE SCALE-UP FROM EXISTING TO LARGE MSF DESALINATION PLANTS,
Aquila Univ. (Italy). Facolta di Ingegneria.
D. Barba, S. Arazzini, and G. Migliorini.
Desalination, Vol. 49, No. 1, p 1-15, January, 1984. 7 Fig, 2 Tab, 7 Ref.

Descriptors: *Desalination plants, Comparison studies, Desalination, Economic evaluation, Performance evaluation, Scale-up desalination plants, Evaporator parameters, Brine flow rate, Flashdown, Froude, Dimensionless vapor velocity.

The trend of building large desalination water stations with a large number of parallel units of 5-6 migd each is critically examined. The opportunity to increase unit size to 12-13 migd for cross tube and to 20-25 migd for long tube geometry has been discussed previously. In this paper optimal sizes analyzed for cross tube and for long tube geometry are 12 migd and 18 migd respectively, and the similarity criteria, that can be used for design purposes starting from the behavior of two reference industrial plants (5 migd cross tube and 8 migd long tube respectively), are illustrated. The scale-up from existing units is based on the similarity of evaporator parameters: brine specific flow rate, flashdown, Froude number at entrance of the stages, dimensionless vapor velocity at the brine release surface, dimensionless vapor velocity through the demisters, two phases flow parameters at the cross-section below the distillate channel (only for cross tube geometry), dimensionless stage length defined as the ratio between actual and critical length. The designs of new large units, characterized by process and geometrical features similar to the reference plants based on these profiles, allows the same water purity and performance ratio for the new capacities. An economic analysis on a standard 6 migd unit shows that the investment cost/cu m/d is about 20% lower for 12 migd cross tube and 30% lower for 18 migd long tube plants. (Author's abstract)
W84-04553

ENERGY SAVINGS IN DISTILLATION PLANTS BY USING VAPOR THERMO-COMPRESSION,
King Abdulaziz Univ., Jeddah (Saudi Arabia). Dept. of Mechanical Engineering.
S. E. Aly.
Desalination, Vol. 49, No. 1, p 37-56, January, 1984. 5 Fig, 13 Ref.

Descriptors: *Distillation plants, *Vapor thermocompression, Desalination, Distillation, Performance evaluation, Thermodynamic analysis, Heat exchangers, Desalination plants.

A suggestion for more efficient utilization of the available energy in single purpose distillation desalination units is presented. It includes the introduction of a vapor thermo-compression multi-effect unit to replace the pressure reducing valves and/or the superheaters usually used at the brine heaters. Furthermore, using the VTC/VTE configurations would allow raising the top effect temperature up to 136 C. The combined system including the VTC/VTE is analyzed and some practical cases are investigated. Thermodynamic analysis showed an increase in the fresh water production by up to 100% with extra heat input of only about 19% of the original plant heat requirements. In the analysis, subatmospheric effects were not used in order to avoid the interference between the jet booster of the vapor compression and the steam jet ejector required to evacuate the non-condensable gases. A flow sheet for the combined system is presented and the operating flexibility is pointed out. Such a system can operate efficiently with favorable response to heat input and demand changes. (Author's abstract)
W84-04554

AN EXPERIMENTAL STUDY OF THE COMPLETE-MIXING MODEL FOR RADIAL FLOW HOLLOW FIBER REVERSE OSMOSIS SYSTEMS,
State Univ. of New York at Buffalo, Amherst. Dept. of Chemical Engineering.
M. Soltanieh, and W. N. Gill.
Desalination, Vol. 49, No. 1, p 57-88, January, 1984. 18 Fig, 3 Tab, 29 Ref. NIH grant BRSGS07-RR-07066-18.

Descriptors: *Complete-mixing model, *Radial flow, *Hollow Fibers, *Reverse osmosis, Permeability coefficient, Desalination, Model studies, Mathematical equations.

The complete mixing model of hollow fiber systems predicts that 1/average R is linear in Sm/Fp, regardless of the membrane transport model which is included in it, and this is confirmed experimentally for the units studied here. The plug flow model, which has been used by all previous investigators, fails to predict this observed fact. It is shown experimentally, by using two radial flow hollow fiber modules of different lengths, that the linear relationship between 1/average R and Sm/Fp exists at all levels of concentration (from 1000 to 35,000 ppm), pressure (from 150 to 400 psi), and feed flow rate (from 75 cu cm/s to 400 cu cm/s). Furthermore, at higher concentrations, plots of 1/average R vs Sm/Fp become independent of concentration and are represented by a single line. The pure water permeability coefficient (A) at 25 C ranges from 7.393 x 10 to the minus 12th power to 9.277 x 10 to the minus 12th power sq cm/s/g for the large module, and from 4.764 x 10 to the minus 12th power to 4.950 x 10 to the minus 12th power sq cm/s/g for the small module when pressure decreases from 400 to 200 psi. Futhermore, A is not a strong function of pressure; it decreases by about 20% for the large module (the more permeable membrane) and about 4% for the small module, when pressure increases by a factor of two. The solute permeability coefficient (K2) determined by two methods is relatively constant with pressure and is a function of concentration only up to a certain level, after which it remains constant. Based on the complete-mixing model, K2 for the large module remains constant at about 1.48 x 10 to the minus 5th power cm/s above a concentration of about 10,000 ppm and for the smaller module (with less permeable membrane) K2 becomes constant at about 0.216 x 10 to the minus 5 cm/s above a concentration of about 5000 ppm. The solute permeabilities calculated from the complete-mixing model are 10 to 25% lower, but show the same trend with concentration as those obtained by using the plug flow approach. (Author's abstract)
W84-04555

APPROPRIATE MINERAL CONTENT OF DESALINATION WATER - THEORY AND DRINKERS' REACTION. PART I,
Italimpianti of Australia Pty Ltd., Sydney.
E. Gabrielli, and J. P. Gerofi.
Desalination, Vol. 49 No. 1, p 95-103, January, 1984. 2 Tab, 20 Ref.

Descriptors: *Desalination, *Drinking water, *Minerals, Sodium, Calcium, Chloride, Metals, Total dissolved solids, Water treatment, Taste.

Reasons for adding inorganic substances to the raw water product from a desalination plant include: making the water more palatable, making the water less aggressive to metal pipes, and to ensure that the resulting water does not cause known health effects. The optimal content of the major ions affecting the quality of drinking water produced by desalination and the remineralization processes by which the various blends can be attained are discussed. Practical criteria indicate that in most cases the total dissolved solids should be in the range of 200-400 mg/l with a content of chloride and sodium ion less than 150 mg/l and 100 mg/l, respectively, and of calcium ion in the range 50-75 mg/l. Hardness should be in the range of 8-20 French degrees, with magnesium and iron less than 10 mg/l and 0.05 mg/l respectively. The concentration of sulfate ion can be anywhere up to a maximum of 200 mg/l. Carbonate ion should be less than 35 mg/l. (Baker-IVI)
W84-04557

3B. Water Yield Improvement

THE NAKDONG ESTUARY BARRAGE AND LAND RECLAMATION PROJECT,
Industrial Sites and Water Resources Development Corp., Seoul (Korea).
For primary bibliographic entry see Field 6G.
W84-04504

NAKDONG ESTUARY BARRAGE AND LAND RECLAMATION - ECOLOGICAL ASPECTS,
Euroconsult, Arnhem (Netherlands).
For primary bibliographic entry see Field 6G.
W84-04505

NAKDONG ESTUARY BARRAGE AND LAND RECLAMATION - MORPHOLOGICAL ASPECTS,
Waterloopkundig Lab., Delft (Netherlands).

For primary bibliographic entry see Field 6G.
W84-04506

WATER QUALITY ASPECTS OF THE NAKDONG ESTUARY BARRAGE,
DHV Consulting Engineers, Amersfoort (Netherlands).
For primary bibliographic entry see Field 6G.
W84-04507

3C. Use Of Water Of Impaired Quality

AGRICULTURAL WASTE WATER - REVERSE OSMOSIS PRETREATMENT,
California State Dept. of Water Resources, Firebaugh.
C. Hild, R. Lindholm, D. Brice, and G. Klein.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-153543, Price codes: A05 in paper copy, A01 in microfiche. Completion Report, June, 1983. 71 p, 12 Fig, 12 Tab, 3 Append. Project No. OWRT C-00211-R (0529) (1), Contract/Grant No. 14-34-0001-0529 (1).

Descriptors: *Reverse osmosis, Desalting, *Ion exchange, *Water softening, Brackish water, Regeneration, Expanded bed, Brine, Recirculation, Automation, *Desalination, Agricultural wastewater, Pretreatment, Pilot plants, Wastewater treatment.

Investigations were made to demonstrate that an ion-exchange (IX) softening system regenerated with reverse-osmosis (RO) reject brine can be operated successfully on a sustained basis to provide softened feed water for an RO system used to desalt brackish water. Various combinations of operating conditions were evaluated to determine sustainable conditions that would produce the largest quantity of softened water per unit of regenerant used. During the investigations, two transparent plastic IX columns were operated alternately in softening and regeneration modes. The resin bed, which was three feet deep during the down flow softening mode, was expanded by 50 and 100 percent of its height during the upflow regeneration mode. RO brine and recirculated regenerant were used to regenerate the IX system. A computer program was used to assess the degree of supersaturation of the regenerant in its course through the IX columns. The IX-RO system was operated in an automated mode to demonstrate that the system could be operated without frequent attention. It was concluded from this study that an IX system regenerated with RO reject Brine can be operated successfully to provide softened feed water for the RO system. The pilot plant operating under optimum conditions produced 1.4 gallons of softened water per gallon of regenerant used. The IX-RO system can be automated.
W84-04232

RENOVATION OF STEAM ELECTRIC POWER PLANT COOLING TOWER BLOWDOWN FOR NON-POTABLE REUSE,
Rexnord, Inc., Milwaukee, WI. EnviroEnergy Technology Center.
For primary bibliographic entry see Field 5F.
W84-04237

DEVELOPMENT AND APPLICATION OF MODELS FOR PLANNING OPTIMAL WATER REUSE,
Texas Univ. at Austin. Center for Research in Water Resources.
L. W. Mays, G. Ocanas, and M. Schwartz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-153527, Price codes: A09 in paper copy, A01 in microfiche. Report OWRT/RU-82/14, U.S. Bureau of Reclamation, Washington, DC., July, 1983. 175 p, 40 Fig, 22 Tab, 68 Ref. Project No. OWRT C-90095-R(9438)(2), Contract/Grant No. 14-34-0001-9438.

Descriptors: *Water reuse, *Optimization, Water supply, *Water quality, *Regional planning, Wastewater treatment, *Optimal development plans, *Optimization models, Software development, Nonlinear programming, Dynamic programming, Reduced gradient methods, Capacity expansion.

Water reuse planning models have been developed for determining the optimum allocation of water and reuse of wastewater on a regional basis for single and multiperiod planning that minimizes the overall cost of water supply. Both water quantity and water quality parameters of various sources of flows can be considered. Wastewater for all use sectors, along with freshwater, can be considered as candidate source or origins of water. The models consider the capacity expansion of treatment facilities and allow for economies of scale in treatment and transportation through the use of nonlinear objective functions. Two basic types of optimization models were developed in this research. The first type are single and multi-period models considered as 'macro-level' models which consider regional planning aspects for relatively large planning periods. These mathematical models are large-scale nonlinear programming (LSNLP) models. The second basic type of models are dynamic programming (DP) models for the detailed optimal selection of treatment alternative (processes). In comparison to the LSNLP modes, these DP models (allocation DP and treatment DP) models consider only a portion of the regional system over a planning horizon with several smaller small time increments.
W84-04240

LYSIMETER STUDIES TO MEASURE WASTEWATER PURIFICATION LEVEL AND NUTRIENT CONCENTRATION IN PERCOLATED WATER (LYSIMETERUNTERSUCHUNGEN ZUR ABWASSERREINIGUNG UND NAHRSTOFFKONZENTRATION IM SICKERWASSER),
Forschungszentrum fuer Bodenfruchtbarkeit Muencheberg(German, D.R.).
L. Forster, O. Muller, and K. Schwarz.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 4, p 138-140, April, 1983. 3 Tab, 10 Ref.

Descriptors: *Wastewater irrigation, *Percolating water, *Wastewater treatment, Land disposal, Nutrient removal, Grass, Crop yield, Nitrogen, Phosphorus, Potassium, Groundwater pollution.

Lysimeter studies were conducted on percolated water under two types of soil (clayey, C, and sandy, S) used in the cultivation of grass (for hay and animal feed) and irrigated with partially purified wastewater. Grass yield in dry volume from C was 154.5, 156.7, and 152.7 dt/ha for 240, 360, and 480 mm wastewater applied, respectively. For S, grass yields were 140.4, 127.8, and 114.1 dt/ha for 360, 480, and 720 mm wastewater, respectively. From an agricultural point of view only a limited amount of wastewater could be applied productively (yield-oriented irrigation). When evaporated water was replaced by a 15% wastewater supplement on C together with mineral fertilization to replace elements removed from the wastewater by preliminary mechanical treatment, a significant crop yield increase occurred (183.2 dt/ha for 490 mm wastewater). This procedure is however not possible in practice. S produced an 11.4-16.3% lower grass yield than C when the same amounts of wastewater were applied. The level of purification achieved, as measured by nitrogen, phosphorus, and potassium concentrations as well as 5-day BOD in percolated water, was markedly better than that of artificial biological wastewater treatment. Used in an appropriate way, agricultural wastewater utilization could achieve purification levels similar to those of third-stage treatment. German Democratic Republic standards for drinking water were violated by phosphorus levels in percolated water under both C and S, by potassium levels under S, and occasionally by NO3-N levels. No violations were found for calcium, magnesium, sodium, or chlorine. (Gish-IVI)
W84-04792

3D. Conservation In Domestic and Municipal Use

ELASTICITY OF DEMAND FOR RESIDENTIAL WATER: POLICY IMPLICATIONS FOR SOUTHERN ARIZONA,
Arizona Univ., Tucson. Coll. of Business and Public Administration.
R. B. Billings, and W. M. Day.
Arizona Review, Vol. 31, No. 2, p 1-11, 1983. 5 Fig, 1 Tab.

Descriptors: *Water conservation, *Pricing, *Water demand, *Arizona, Tucson, Water use, Public policy, Decision making, Planning.

A comprehensive analysis was undertaken in southern Arizona of the response of residential water use to pricing, economic, demographic and weather variables. Findings which are important for water policy decision making are reported. The major trend observed was decreased average residential water use. Average use declined by about 38% from 1974 to 1980, a period in which real inflation-adjusted costs of water and sewer services increased 52%. During the past 9 years residential customers in Tucson reduced their water use by about 7% for each 10% increase in the real (inflation-adjusted) average price of the water. For each 10% increase in the index of water publicity, water use fell by about 1% during the crisis period, but by slightly less than half this amount during normal times. Given that price increases do promote water conservation, a difficult issue facing policy makers is the justification of a price in excess of that required to cover utility operating costs in order to force additional conservation. (Baker-IVI)
W84-04388

WATER CONSERVATION: THE STRUGGLE OVER DEFINITION,
Southern Illinois Univ. at Carbondale. Dept. of Geography.
D. D. Baumann, J. J. Boland, and J. H. Sims.
Water Resources Research, Vol. 20, No. 4, p 428-434, April, 1984. 3 Tab, 27 Ref. Army Corps of Engineers, Institute for Water Resources contract DACW72-78-C-0022.

Descriptors: *Water conservation, *Definition, Water management, Metropolitan water management, Water supply, Optimization.

During the 1970's much attention was focused on the role of water conservation in the planning and management of urban water supplies, and actions to implement water conservation were taken at all levels of government. Yet many policies and programs appear to rely on conceptions of water conservation which confuse supply and demand oriented strategies or which inefficiently conserve water at the expense of other scarce resources. Through an analysis of the underlying concepts and values, a definition of water conservation is reached which is both precise and practical and which provides a sound basis for the development of water conservation policies. Examples drawn from recent field studies illustrate the application of the definition. (Author's abstract)
W84-04566

3E. Conservation In Industry

WATER RECYCLE IN THE ORGANIC CHEMICAL AND PLASTIC MATERIALS INDUSTRIES,
Centec Corp., Reston, VA.
P. Crampton, A. Procko, D. Sherman, and J. Boutross.
Available from the National Technical Information Services, Springfield, VA 22161 as PB84169416, Price codes: A09 in paper copy, A01 in microfiche. Report OWRT/RU-82/18, Bureau of Reclamation, Washington, D.C., July, 1983. 164 p, 25 Fig, 26 Tab, 10 Ref, 2 Append. Projects No. 90181-R (04 OWRT 73) (1), Contract No. 14-3400001-0473.

Descriptors: *Alternative water use, *Industrial water use, *Industrial cooling water, *Wastewater treatment, *Water reuse, *Water softening, *Advanced wastewater treatment, Chemical industry, Chemical wastes, Coagulation, Groundwater availability, Municipal wastewater, Chemical sludge, Sludge disposal.

Findings are presented of a study to assess the potential for fresh water withdrawals in the Organic Chemical and Plastic Materials industry by internal recycle of water or the use of reclaimed municipal effluent. Broadly applicable water recycle options were evaluated in terms of the impact of total water withdrawal for individual facilities, specific products, individual water resource region, and the industry as a whole. The report concludes that currently available technology, if broadly applied, has the potential to significantly reduce water withdrawals by the industry. The recycle options evaluated have proved successful in the limited applications implemented at this time. Recommendations for future activity to foster implementation of water recycle options are also presented.
W84-04406

RESULTS AND GOALS OF THE SAALE-WERRA WATER MANAGEMENT AREA IN RATIONAL WATER USE (ERGEBNISSE UND AUFGABEN DER WASSERWIRTSCHAFTS-DIREKTION SAALE-WERRA BEI DER RATIONELLEN WASSERVERWENDUNG),
Wasserwirtschaftsdirektion Saale-Werra, Halle (German D.R.).
G. Franke.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 3, p 89-90, March, 1983.

Descriptors: *Water management, *Water conservation, *East Germany, Water use, Industrial water, Water demand, Wastewater treatment.

Efforts of the Saale-Werra Water Management Area (German Democratic Republic) to realize the goals set for the water industry by the 1983 Economic Plan are described. Unfavorable hydrologic conditions exist, but the 'Directive for Rational Water Use in the Five-Year Plan 1981/85' provides guidelines, and the 1982 water law provides the means for implementation. The Saale-Werra Area (29,000 sq km) covers 27% of the GDR and contains 35% (5.9 million) of its population. It has 78,000 water users, whose 3.7 billion cu m/yr (3 million from surface water) demand can be covered in a stable fashion by its 104 reservoirs (450 million cu m capacity) and the multipurpose Saale Valley dam facility. The 10 biggest users require 52% of the total industrial water demand. Institution of rational water use resulted in a 0.2% increase in water use from 1980 to 1981, well under the 1% increase allowed by the 'Directive.' The goal of cutting specific water demand by 5% was not met (a reduction of 4.2% was achieved) because an unavoidable increase in demand occurred in the Leipzig and Suhl districts. Goals for rational water use in 1983 include reductions in use losses upstream of the standard user to ensure a full supply to the standard user, efforts on the part of the main user to decrease demand, and the addition of small streams needed for agriculture to the main work when the supply to industry is failing. Wastewater treatment must be improved by reclaiming valuable chemicals and minerals, by start-up of the first level of biological treatment at the Espenhain brown coal refinery and of a salt-diversion facility at another plant, continuation of biological treatment at the Buna chemical works and of the Leipzig-Rosental municipal wastewater treatment plant. (Gish-IVI)
W84-04779

3F. Conservation In Agriculture

ESTIMATING 1980 GROUND-WATER PUMPAGE FOR IRRIGATION ON THE HIGH PLAINS IN PARTS OF COLORADO, KANSAS, NEBRASKA, NEW MEXICO, OKLAHOMA, SOUTH DAKOTA, TEXAS, AND WYOMING,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 4B.
W84-04257

WATER-USE EFFICIENCY IN CROP PRODUCTION,
Florida Univ., Gainesville. Dept. of Agronomy.
For primary bibliographic entry see Field 2I.
W84-04284

AGRICULTURAL DEMAND FOR WATER IN LOWLAND AREAS,
D. Evans.
Journal of the Institution of Water Engineers and Scientists, Vol. 37, No. 6, p 513-521, December, 1980. 6 Fig, 6 Ref.

Descriptors: *Water demand, *Water resources development, *Agriculture, *England, Irrigation, Sub-irrigation, Spray irrigation, Crop yield, Water supply.

In 1980 the Government's Advisory Council for Agriculture and Horticulture (ACAH) produced a report on the future needs of water for agriculture in the lowland areas of England. Water for livestock was identified as the largest component of agricultural demand. Water for crops is dealt with, including both spray irrigation and sub-irrigation plans as well as crops which are grown in water. ACAH has predicted a four-fold increase in irrigation needs, but it is uncertain if this figure will become fact. A policy decision has been made by the Anglian Water Authority to make raw water available where it is economic to do so, in national terms, and to develop a method of cost-benefit appraisal of relevant schemes. (Baker-IVI)
W84-04314

OPTIMUM WATER USE BY STONE FRUIT THROUGH IRRIGATION SCHEDULING,
Michigan State Univ., East Lansing. Dept. of Horticulture.
For primary bibliographic entry see Field 2I.
W84-04408

NITROGEN AND YIELD AS RELATED TO WATER USE OF SPRING BARLEY,
New Mexico State Univ., Las Cruces. Dept. of Agricultural Engineering.
C. E. Kalisen, T. W. Sammis, and E. J. Gregory.
Agronomy Journal, Vol. 76, No. 1, p 59-64, January-February, 1984. 4 Fig, 5 Tab, 18 Ref.

Descriptors: *Evaporation, *Crop yield, Barley, Evapotranspiration, Transpiration, Nitrogen, Water use, Efficiency.

The water production function is the relationship between marketable crop yield and seasonal evapotranspiration. Variability in the parameters of the function for different growing seasons results in error in estimating the effect of a water management strategy on yield. Experiments were conducted to determine if the parameters describing the functional relationship between transpiration and yield for field grown spring barley was stable for different levels of nitrogen fertility and seasonal differences in the atmospheric evaporative demand. N fertility did not affect water use efficiency (WUE) when efficiency is expressed as the weight of grain yield produced per depth of water transpired. The level of N fertility may affect the WUE when the WUE is expressed as the weight of grain yield produced per depth of water evapotranspired, as a result of differences in the evaporation component associated with the interaction of the irrigation frequency with the degree of ground cover achieved by the crop. (Baker-IVI)
W84-04417

SIZE DISTRIBUTION OF THE ON-FARM IRRIGATION PUMPING PLANTS IN THE U.S.,
Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
J. R. Gilley, D. L. Martin, and R. N. Clark.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 2, p 406-411, March-April, 1983. 6 Fig, 4 Tab, 3 Ref.

Descriptors: *Irrigation, *Pumping plants, Colorado, Kansas, Nebraska, New Mexico, Oklahoma, Texas, United States.

Over 473,000 on-farm pumping plants were used to pump and deliver irrigation water in the United States in 1979. Over 60% of these units were smaller than 37.3 kW (100 hr). Two steps were necessary to estimate the number of pumping plants in the different size categories using groundwater sources. First, the distribution of the various pump sizes required for the different irrigations was determined and second the total number of units used for a particular irrigation system was estimated. The distribution of the pumping plant sizes for the various irrigation systems was determined using the system flow rate and pumping lift data. Nearly one-half of the pumping plants (231,440) were located in the six High Plains States of Colorado, Kansas, Nebraska, New Mexico, Oklahoma and Texas. (Baker-IVI)
W84-04423

EVALUATION OF A WATER MANAGEMENT MODEL FOR IRRIGATED AGRICULTURE,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
A. C. Chang, R. W. Skaggs, L. F. Hermsmeier, and W. R. Johnston.
Transaction of the American Society of Agricultural Engineers, Vol. 2, No. 2, p 412-422, March-April, 1983. 4 Ref 6 Tab, 27 Ref.

Descriptors: *Model studies, *Irrigation, *Water management, DRAINMOD, Computers, Seepage, Water table, Evaluation, Management.

DRAINMOD is a computer model simulating the movement and storage of water in soils with a shallow water table in the humid region. The model was developed for the comprehensive analysis of soil water transformation on a field scale where most water management facilities are designed and installed as a single unit. DRAINMOD was used to simulate the water balance in an irrigated cropland. Water table elevations predicted by DRAINMOD agreed reasonably well with measurements for 5 experimental locations differing in soil texture in the San Joaquin Valley and the Imperial Valley of California. Water loss by deep seepage is a significant component in soil water balance for irrigated crop land tested. When the water table drawdown exceeded 150 cm, the model tended to overestimate the depth of water table. (Baker-IVI)
W84-04424

FIELD QUANTIFICATION OF CROP WATER STRESS,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 2I.
W84-04440

LEPA IRRIGATION SYSTEM EVALUATION,
Texas Agricultural Experiment Station, Lubbock.
W. M. Lyle, and J. P. Bordovsky.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 3, p 776-781, May-June, 1983. 1 Fig, 7 Tab, 4 Ref.

Descriptors: *Low energy precision application, *Irrigation efficiency, Sprinkler irrigation, Furrow irrigation, Cost analysis, Soybeans, Micro-basin tillage.

The LEPA (Low Energy Precision Application) irrigation system distributes water directly to the furrow at very low pressure through drop tubes and emitters which are located at a height of 5 to 10 cm above the furrow. The system was designed to minimize the effect of soil and climatic variables which adversely influence furrow and sprinkler irrigation efficiencies. It was also designed to maximize rainfall utilization by conjunctive use with micro-basin tillage. The LEPA (Low Energy Precision Application) irrigation concept has been extensively tested for two years and compared with sprinkler and furrow methods. The evaluation in-

cluded application efficiency, distribution efficiency, water use efficiency and energy savings potential. The LEPA performance was consistantly high in all areas evaluated and fluctuated over a very narrow range, indicating that the objective was successfully met. Soybeans were used as a test crop and the yield data support the irrigation efficiency results and indicate an economic justification for conversions to LEPA irrigation. (Moore-IVI)
W84-04441

OPTIMIZING FURROW IRRIGATION RUNOFF RECOVERY SYSTEMS,
Colorado State Univ., Fort Collins. Dept. of Chemical Engineering.
J. M. Reddy, and W. Clyma.
Transactions of the American Society of Agricultural Engineers, Vol. 25, No. 4, p 1050-1056 and 1063, July-August, 1983. 1 Fig, 4 Tab, 23 Ref. USAID contract AID/DSAN-C-0058.

Descriptors: *Furrow irrigation, *Irrigation design, *Runoff recovery, Optimization, Cost analysis, Geometric programming.

Design parameters of a furrow irrigation runoff recovery system were optimized using the generalized geometric programming technique. The cost of pumping water from the well and the sump, the cost of labor, and the cost of constructing the sump were considered in the objective function. The major constraints specified were on the requirement depth and the volume of runoff at the end of irrigation (specified to be zero). A sample problem was solved using the geometric programming technique. The cost of system design using the present technique ($184/ha) was significantly cheaper than the trial and error solution ($275/ha). This increase in the cost of system design was mainly due to the difference in the volume of runoff collected in the sump. The trial and error solutions are tedious and constraints cannot be directly included in the design process. Conversely, the system constraints and cost coefficients can be directly incorporated into the optimization technique. Irrigation runoff recovery systems can be designed effectively for minimum cost using the optimization technique. (Moore-IVI)
W84-04447

DESIGN OF GRASS-LINED OPEN CHANNELS,
Agricultural Research Service, Stillwater, OK. Crop Production and Water Conservation Lab.
D. M. Temple.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 4, p 1064-1069, July-August, 1983. 2 Tab, 9 Ref, 3 Append.

Descriptors: *Tractive forces, *Grassed waterways, *Open channels, *Design, Mathematical models, Linings, Soil conservation, Sediment transport, Stability, Vegetation.

Grass linings may provide an attractive alternative to structural stabilization methods for earth channels exposed to flow only intermittently. Recent advances in the understanding of the behavior of flow over vegetation is placed into the format of a numerical design procedure for grass-lined channels. A step by step computational procedure for stability design is presented with example computations and a discussion of the required parameters. The procedure is semiempirical and was formulated using a dominant parameter approach. Thus it cannot replace engineering judgment as an essential part of the design process. In addition to its numerical format, the advantages of the outlined procedure include reduced subjectivity in vegetal retardance estimation and increased flexibility in application. By separating the influence of the vegetal action from soil and geometry consideration, designs may be reasonably modified to reflect local conditions. (Baker-IVI)
W84-04449

SPRAY LOSSES AND PARTITIONING OF WATER UNDER A CENTER PIVOT SPRINKLER SYSTEM,
Agricultural Research Service, Bushland, TX. Conservation and Production Lab.
J. L. Steiner, E. T. Kanemasu, and R. N. Clark.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 4, p 1128-1134, July-August, 1983. 4 Fig, 5 Tab, 26 Ref.

Descriptors: *Center pivot irrigation, *Sprinkler irrigation, *Spray losses, Corn, Vapor pressure, Water partitioning, Wind, Air temperature, Canopy, Stemflow, Interception.

Center pivot irrigation is extensive in the Great Plains agricultural regions. The efficiency of a center pivot sprinkler system was analyzed by monitoring spray losses under various climatic conditions and by examining the partitioning of water within a corn (Zea mays L.) canopy. Average spray losses were 12% in 1980 and 16% in 1981. Spray losses were significantly correlated with vapor pressure deficit ($r_{x,y} = 0.49$), temperature ($r_{x,y} = 0.47$) and a wind-vapor pressure deficit term ($r_{x,y} = 0.45$). The unexplained variability in the data may be attributed to the difficulty of determining the exact application rate at a particular area of the field and to the interaction between climatic conditions and wind orientation relative to the sprinkler lateral. Under full canopy condition in corn, about half of the water reaching the soil surface is via stemflow with the remainder falling or dripping through to the soil surface. We found 2.7 mm of canopy storage in a full corn canopy. Net loss of plant intercepted water depends on the temperature and on the ratio of canopy (rc) and aerodynamic (ra) resistances to vapor flux, with net losses being small if rc/ra is low and temperatures are high. (Author's abstract)
W84-04458

UNIFORMITY DESIGN CRITERIA UNDER LIMITED WATER,
Tennessee Univ., Knoxville. Dept. of Agricultural Engineering.
R. D. von Bernuth.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 5, p 1418-1421, September-October, 1983. 2 Fig, 1 Tab, 10 Ref.

Descriptors: *Sprinkler irrigation, *Design criteria, *Available water, *Uniformity, Irrigation water, Mathematical models, Economic aspects.

Traditional uniformity design criteria for set type sprinkler irrigation systems has included a minimum design coefficient of uniformity (CU). When the total water available for irrigation under set type irrigation is limited, the economically optimal design CU becomes a function of the crop response to water. The LaGrangean constrained maximization technique can be used to determine optimal uniformity design criteria. When the amount of irrigation water available is limited, the design coefficient of uniformity will vary with local conditions and prices, and may well be less than traditional values. The statistical moments needed to determine the optimal design CU depend upon the order of the function used to describe production. In theory, no optimal CU exists for the purely linear production function, but in actuality one does exist because there must be some upper limit on production. (Moore-IVI)
W84-04468

INFILTRATION AND SUBSEQUENT EVAPORATION FROM SURFACE-AGGREGATED LAYERED SOIL PROFILES UNDER SIMULATED LABORATORY CONDITIONS,
Ghent Rijksuniversiteit (Belgium). Lab. of Soil Physics, Soil Conditioning and Horticultural Soil Science.
For primary bibliographic entry see Field 2G.
W84-04514

EFFECT OF IRRIGATION ON THE PHYSICAL PROPERTIES OF DARK CHESTNUT SOLONETZIC SOILS, NORTHERN CRIMEA,
P. I. Kukoba, and S. A. Balyuk.
Soviet Soil Science, Vol. 15, No. 2, p 104-110, 1983. 6 Tab, 18 Ref. Translated from Pochvovedeniye, No. 4, p 91-97, 1983.

Descriptors: *Irrigation effects, *Soil properties, *Crimea, *USSR, Solonetzic soils, Soil water, Argillization, Compaction, Porosity, Permeability, Soil physical properties.

Changes made by irrigation practices in the physical properties of dark Chestnut Solonetzic soils in the Bay of Sivash region of the Northern Crimean Irrigated Massif were described. The study of particle size, microaggregate composition, and hydrophysical properties demonstrates that irrigation causes significant, statistically demonstrable changes in the properties of the upper soil horizons. In irrigated soils with normal cultivation there is a tendency for irrigation argillization, an increase in the dispersion of aggregates, and the destruction of soil structure. Bulk density increases in irrigated soils and the total porosity, aeration porosity, and permeability all decrease. Meliorative trench and deep (40 cm) plowing with the application of 5 tons/ha phosphogypsum not only prevent the deterioration of the physical properties of irrigated soils, but also significantly improve them. (Baker-IVI)
W84-04525

EFFECT OF CALCIUM ON WATER-STRESS-INDUCED BIOCHEMICAL CHANGES AND YIELD OF FIELD-GROWN RICE,
Burdwan Univ. (India). Plant Physiology and Biochemistry Lab.
B. Nayek, A. K. Biswas, Jr., and M. A. Choudhuri.
Biologia Plantarum (Praha), Vol. 25, No. 2, p 117-123, 1983. 1 Fig, 2 Tab, 25 Ref.

Descriptors: *Water stress, *Calcium, *Rice, Plant water potential, Water content, Proline, Chlorophyll, Crop yield.

Three different treatments by calcium (0.001 M), namely seed treatment, foliar spraying and their combination were applied on field-grown rice (Oryza sativa L. ev. Ratna) under both water stressed and non-stressed conditions in the course of plant development. The relative water content and leaf water potential decreased with increase in age of stressed and non-stressed plants. Pretreatment of seeds with Ca improved the water status of the plants most prominently at the vegetative stage but the effect gradually faded away with plant development. The foliar spraying by Ca was more effective in improving the water status of the plants at the reproductive stage. The combined Ca treatment signficantly improved water status of the plants both at the vegetative and reproductive stages. The contents of chlorophyll and protein decreased and the activities of protease and RNase increased in the course of plant development in both non-stressed and even more in stressed plants. Ca treatments of seeds or plants or their combination inhibited the decline in chlorophyll and protein contents and the rising trends of protease and RNase activities, the combined treatment being most effective. During plant development free proline content increased significantly more in water stressed plants. In non-stressed plants there was a marked increase in the free proline content as the mature fruit stage. Ca treatment inhibited the rise of free proline in stressed plants. A significant reduction in yield components and yield of the crop in water stressed plants was increased by Ca treatment. (Author's abstract)
W84-04773

DIURNAL VARIATION IN LEAF WATER POTENTIAL, STOMATAL CONDUCTANCE, AND IRRADIANCE OF WINTER CROP UNDER DIFFERENT MOISTURE LEVELS,
Haryana Agricultural Univ., Hissar (India). Dept. of Agronomy.
P. Rao, and S. K. Agarwal.
Biologia Plantarum (Praha), Vol. 26, No. 1, p 1-4, 1984. 2 Fig, 1 Tab, 6 Ref.

Descriptors: *Irrigation effects, *Plant water potential, *Stomatal conductance, *Irradiance, Diurnal variation, Mustard, Chickpea, Barley, Soil temperature, Leaf temperature, Relfectance.

Mustard (Brassica juncea Coss.), chickpea (Cicer arietinum L.) and barley (Hordeum vulgare L.) were grown under different moisture levels. Diurnal changes in leaf water potential showed lower values and higher fluctuation in mustard, chickpea and barley grown with no irrigation as compared to one supplemental irrigation. Diurnal maximum of adaxial stomatal conductance in mustard and barley was higher under one irrigation treatment. In mustard stomatal conductance of abaxial surface of leaf remained higher than adaxial surface of leaf throughout the day, wherease the reverse was true in barley. Also the leaf and soil temperature and reflectance were slightly higher in all the three crops under no irrigation. (Author's abstract)
W84-04776

RESULTS AND GOALS OF RATIONAL WATER USE AND WATER CONSERVATION IN SOCIALIST AGRICULTURE (ERGEBNISSE UND AUFGABEN BEI DER RATIONELLEN WASSERVERWENDUNG UND DEM SCHUTZ DER GEWASSER IN DER SOZIALISTISCHEN LANDWIRTSCHAFT),
E. Clausnitzer.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 4, p 111, April, 1983.

Descriptors: *Water conservation, *Water quality control, *East Germany, *Agriculture, Irrigation water, Water demand, Water use, Farm wastes, Groundwater pollution, Water reuse.

The directive on rational water use in the Five-Year Plan 1981/85 of the German Democratic Republic (GDR) sets concrete goals for socialist agriculture, including reducing by 10-15% water used in newly created overhead irrigation areas, minimization of water use and wastewater in the animal products industry, reclamation of valuable substances from wastewater in the food industry, introduction of water-conserving technology and facilities for agricultural cooling and flushing processes, and to institute liquid-manure, silage, dunging, and pest control procedures that will not impair ground water. Significant successes have been achieved with water-conserving drinking devices for animals, stable-cleaning techniques using little water, and impulse and root irrigation procedures. Rational water use saves fuel and allows wastewater recycling, e.g., for farmyard cleaning. In the GDR, 58% of the total drainage and new formation of groundwater comes from agricultural land, making control of liquid manure a necessity. In 1982, in compliance with the new water law, storage capacity for liquid manure was increased by 979,000 cu m, that for dung water by 210,000 cu m, and that for dung by 320,000 sq m. In 1983 and thereafter, agricultural and water-management organizations will work together to plan rational water use and water protection measures. By 1985, 80% of water use in agriculture should conform to standards. (Gish-IVI)
W84-04785

THE CONTRIBUTION OF SOCIALIST AGRICULTURE TO THE IMPLEMENTATION OF THE SPECIFICATIONS OF THE NEW WATER LAW (DER BEITRAG DER SOZIALISTISCHEN LANDWIRTSCHAFT ZUR DURCHSETZUNG DER BESTIMMUNGEN DES NEUEN WASSERGESETZES),
G. Pallmann.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 4, p 112-113, April, 1983.

Descriptors: *Water conservation, *Agriculture, *Water pollution control, *East Germany, Water use, Drainage, Irrigation, Farm wastes, Manure, Water management, Fertilizers, Agricultural chemicals, Land use.

The most important contribution of agriculture to the implementation of the German Democratic Republic's water law of 7/2/1982 is effective land use, which is the best guarantee for rational water use and water conservation. In 1983, facilities to increase the present 1,605 million hectares (ha) of drained land by 65,000 ha will be constructed. Up to 40 million cu m/yr overhead-irrigation water is being saved, and a further 50-100 cu m/ha saving is expected. A program to increase storage space for liquid manure, dung water, and dung by 1985 is being developed in cooperation with water management organizations. Increasing the content of dry matter in liquid manure is important for effective fertilization, and this begins with using the least possible amount of water in animal-products plants and separate collection of plant wastewater. A system of standards for the preparation and utilization of liquid manure is being developed to be binding from 4/1/1983. Water pollution caused by careless use of fertilizers can be avoided with well-chosen agricultural methods while retaining high crop yields; this is important, since it will be necessary to utilize 0.5 million ha of land in water-conservation areas for agriculture in future. (Gish-IVI)
W84-04786

WATER DEMAND STANDARDS IN DAIRY FARMING (WASSERBEDARFSNORMEN IN DER RINDERPRODUKTION),
Akademie der Wissenschaften der DDR, Iden-Rohrbeck. Inst. fuer Rinderproduktion.
For primary bibliographic entry see Field 6D.
W84-04787

INFORMATION AND RECOMMENDATIONS ON TOPICAL QUESTIONS CONCERNING WATER CONSERVATION BY MEANS OF SOIL TREATMENT WITH WASTEWATER (INFORMATIONEN UND EMPFEHLUNGEN ZU AKTUELLEN FRAGEN DES GEWASSERSCHUTZES DURCH ABWASSERBODENBEHANDLUNG),
For primary bibliographic entry see Field 5D.
W84-04788

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

STREAMFLOW LOSSES AND CHANGES IN GROUND-WATER LEVELS ALONG THE SALE AND GILA RIVERS NEAR PHOENIX, ARIZONA - FEBRUARY 1978 TO JUNE 1980,
Geological Survey, Tucson, AZ. Water Resources Div.
L. J. Mann, and P. B. Rohne, Jr.
Available from the Ofss, USGS, Lakewood, CO 80225, Price: $5.75 paper copy, $5.00 microfiche. USGS Water-Resources Investigations report 83-4043, April, 1983. 11 p, 6 Fig, 3 Tab, 3 Ref.

Descriptors: *Streamflow, *Channel loss, *Groundwater levels, Infiltration rate, Groundwater development, *Arizona, Phoenix, Salt River, Gila River.

From March 1978 to June 1980, high runoff from the Salt and Verde drainage basins combined with large carryover storage in a reservoir system led to the release of about 8.26 million acre-feet of water. About 2.89 million acre-feet of the water was diverted above Granite Reef Dam, and about 5.45 million acre-feet was released into the normally dry channel of the Salt River. The total streamflow losses in the 74-mile reach between Granite Reef and Gillespie Dams were at least 474,000 acre-feet. Most of the water infiltrated into the permeable alluvial deposits along the Sal and Gila Rivers and increased the amount of ground water in storage. From February 1978 to May 1980, ground-water levels in 169 wells that tap the alluvial deposits in the Salt River Valley rose an average of 35.5 feet. The rise in ground-water levels was a direct result of the infiltrating floodwaters and a marked decrease in ground-water pumpage. (USGS)
W84-04264

SEVERN ESTUARY - AN APPRAISAL OF WATER QUALITY,
Welsh Water Authority, Powys (Wales). Directorate of Scientific Services.
For primary bibliographic entry see Field 5A.
W84-04332

32-P UPTAKE IN THREE SUBMERGED AQUATIC PLANT SPECIES,
Visva-Bharati Univ., Santiniketan. Dept. of Botany.
S. Jana, and M. A. Choudhuri.
Hydrobiological Bulletin, Vol. 17, No. 2, p 97-101, December, 1983. 2 Tab. 19 Ref.

Descriptors: *Plant growth, *Aquatic weed control, Phosphorus, Macrophytes, India, Kinetin, Ethrel, ABA, Growth regulators.

The uptake of 32-P at various developmental stages of three macrophytes (Potamogeton pectinatus, Vallisneria spiralis, Hydrilla verticillata) was measured. The effects of three growth regulators on this process was quantified: kinetin, a senescence inhibitor, ethrel and ABA, both senescence promoting substances. The highest 32-P uptake was noted among the young shoots of the plant species; the lowest by the old ones. Kinetin pretreatment increased the uptake while ethrel and ABA decreased it in all species. P-32 was transported to the largest extent to the young shoots of the submerged plants and to the smallest extent to the old ones by kinetin pretreatment. Kinetin enhanced the uptake most in Hydrilla shoots, followed by Vallisneria and Potamogeton. Ethrel diminished uptake most in Potamogeton shoots and to the smallest extent in Hydrilla, while ABA lowered it most in Hydrilla shoots and to the least in Potamogeton. (Baker-IVI)
W84-04376

VEGETATION LINED CHANNEL DESIGN PROCEDURES,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
J. E. P. Green, and J. E. Garton.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 2, p 436-439, March-April, 1983. 3 Fig, 3 Tab, 9 Ref.

Descriptors: *Channels, *Vegetation, Linings, Design criteria, Stability, Flow, Velocity.

Graphical and numerical design procedures for the design of vegetation-lined trapezoidal, parabolic, and triangular channels are presented. The procedures are based upon the Manning formula and the n-VR relationships of vegetation linings for five retardance classes. The numerical solution presented is an iteration process within the capabilities of a scientific pocket calculator. The graphical design procedure can be executed rapidly and compares favorably with numerical solutions. The numerical and graphical design results for more than 240 parabolic and trapezoidal channels were subjected to a linear regression analysis. There were no significant differences between the design values of depth and velocity of flow determined by means of the numerical of graphical procedures. The graphical procedure is also extremely flexible. Starting with the maximum permissible velocity, the optimum channel width and depth of flow can be determined. The maximum discharge capacity of an existing channel can be determined quickly and conveniently in the field as well. This method should allow designers to consider many alternative designs that might otherwise go unconsidered. (Baker-IVI)
W84-04427

DRAINAGE NEEDS AND RETURNS IN NORTH-CENTRAL IOWA,
R. S. Kanwar, H. P. Johnson, D. Schult, T. E. Fenton, and R. D. Hickman.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 2, p 457-464, March-April, 1983. 2 Fig, 6 Tab, 14 Ref.

Descriptors: *Drainage, *River basins, Des Moines River, Water management, Crop yield.

Current status of drainage and estimated drainage needs of the soils in the Des Moines River basin as indicated from an extensive survey are presented. Ninety-five percent of the area in the basin lies within low-success districts with inadequate district mains. Of this area, 69% already has a high level of on-the-farm drainage systems designed at 1.27 cm drainage coefficient at the field level. Therefore, it only district mains in the low-success districts are improved from the present low level of drainage to a high level of drainage, more than 80% of the potential benefits could be received in low-success districts. If individual farmers have to make an investment for drainage improvement on their farms, very poorly drained and poorly drained soils should be considered first because these soils give the highest benefit/cost ratios, particularly for corn and soybean production. (Baker-IVI)
W84-04429

OPTIMAL IRRIGATION DISTRIBUTION SYSTEMS WITH INTERNAL STORAGE,
Idaho Univ., Moscow. Dept. of Agricultural Engineering.
M. J. Khanjani, and J. R. Busch.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 3, p 743-747, May-June, 1983. 3 Fig, 7 Tab, 10 Ref.

Descriptors: *Irrigation systems, *Farm service reservoirs, *Water storage, Optimization, Linear programming, Mixed integer programming, Cost analysis, Water conveyance, Water distribution.

A method was developed for planning an irrigation distribution system with internal storages that would supply water on a modified demand schedule so that adequate farm deliveries could be made during a portion of each day as demanded. By using internal farm service reservoirs, continuous flow into and through much of the system is possible with the reservoirs being used to store water for limited periods of time. This stored water can then be used on demand by irrigators. The method specifies the optimal sizes and locations of farm service reservoirs within an irrigation system. The resulting optimal plan is the least cost system for temporarily storing water so that irrigators can obtain irrigation water upon demand during a fraction of each day and thereby used water more effectively. Mixed integer programming is used in conjunction with linear programming to produce optimal plans for an irrigation conveyance and distribution system incorporating farm service reservoirs. The locations and sizes can be specified for the reservoirs used to temporarily store irrigation water. The procedure used can incorporate different constraints that deal with physical, management, and insittutional aspects. (Moore-IVI)
W84-04435

DEWATERING DREDGED SEDIMENT FOR AGRICULTURE,
Illinois Univ. at Urbana-Champaign. Dept. of Agronomy.
W. D. Lembke, J. K. Mitchell, J. B. Fehrenbacher, and M. J. Barcelona.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 3, p 805-808 and 813, May-June, 1983. 7 Fig, 2 Tab, 8 Ref.

Descriptors: *Dewatering, *Lake sediments, *Land disposal, *Dredging, *Reservoirs, *Drainage, Lake Paradise, Illinois, Terrace channels, Tile outlet terraces, Sand filters, Water supply, Water quality control, Soil erosion.

Artificial impoundments for water supply can be dredged to remove sediments and restore their capacity. In many cases, the sediment in the lakes is the result of soil erosion from adjacent farm land. The feasibility of using lake bed sediment for agricultural production was investigated, using sediment from Lake Paradise, once the water supply for Mattoon, Illinois. Lake bed sediments was used in two studies: a hauled sediment study using relatively dry sediment having 23% clay and a hydraulically dredged sediment study using sediment having 30% clay. The hauled sediment plots produced a significantly higher corn yield than the check plots. The corn of the check plots showed a more severe moisture stress during a dry period in July. The additional organic matter on the hauled sediment plots provided a greater water holding capacity. The high water content of the sediment below the crust on the hauled sediment plots provided a water supply for the corn during the stress period in July. The increased yield of the hauled sediment plots provides an incentive for using the lake bed sediments in terrace channels on eroded soil where reduced yields are frequently a problem. The combination of tile outlet terraces and sand filters over subsurface drains was an effective method of dewatering sediment in terrace channels. The terraces prevented the sediment from returning to the lake and also substantially reduced further erosion of the watershed. The surface inlets removed the supernatant during the sedimentation process and removed surface water during consolidation of the sediment. The dewatering process occurred with a minimal effect on lake water quality. (Moore-IVI)
W84-04444

COST FUNCTIONS OF WATER CONVEYANCES FOR GRAVITY IRRIGATION,
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Agricultural Engineering.
R. C. Yadav.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 4, p 1090-1096 and 1101, July-August, 1983. 4 Fig, 7 Tab, 12 Ref.

Descriptors: *Water conveyance, *Gravity irrigation, *Cost analysis, *Open channels, *Pipelines, Conveyance structures, Irrigation projects, Mathematical equations.

In gravity irrigation systems, conveyance of water from a source to the point from which it can be fed into the field distributions system is a problem which can be solved by several technical methods, including open channels on raised earthen embankments, open channels elevated on piers, and underground pipelines. In the proposed method, water is conveyed through pipe to a suitable point beyond which it can be conveyed in an open channel. The point where switching from pipe to open channel is located where the cost of conveyance through pipes becomes higher than through open channel. The most economical conveyance using underground pipe and open channel in a definite proportion can conveniently be designed with the mathematical expression that comprises unit costs of work and materials and some easily determined coefficients and exponent values for an irrigation project. The overall saving (expressed as percent cost of conveyance with unlined channel) with the combined system so designed for a particular case was 82% as against 80% with underground pipe and 72% with lined open channel. (Moore-IVI)
W84-04452

WATER DISTRIBUTIONS WITH INITIAL STATIONARY SETS IN TRAVELER IRRIGATION,
Auburn Univ., AL. Dept. of Agricultural Engineering.
E. W. Rochester.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 4, p 1105-1108, July-August, 1983. 9 Fig, 3 Tab, 3 Ref.

Descriptors: *Sprinkler irrrigation, *Traveler irrigation, *Application rates, *Stationary sets, Simulation, Wetting arc, Lane length, Travel speed.

A series of digital simulations was conducted to determine the effect of an initial stationary set on traveler irrigation application depths. Sprinkler wetting arcs were varied from 360 to 180 degrees. One sprinkler application-rate distribution was obtained for a Rain Bird 205 G sprinkler with a ring orifice and the second was a uniform application-rate pattern having the same flowrate and wetting radius as the Rain Bird sprinkler. Initial stationary set can extend the effective lane lengths in traveler irrigation. Extending the effective lane length with stationary sets decreases the volume of water discharged beyond the effective field boundary. Extending the effective lane length with stationary sets increases the volume of excess water applied to the field area. Total non-utilized water remains relatively constant for initial stationary sets which produce L/R values values less that 0.4 but increases for larger L/R values. Decreasing the sprinkler wetting arc from 360 degrees decreases the required delay time and the total volume of non-utilized water. The location where excess water is applied is midway between travel lanes and near the non-end affected field region. Decreasing the sprinkler wetting arc from 360 degrees to 180 degrees causes the position of the excess wetted zone to be shifted toward the start end of the field. Lane spacing has no effect on the volume of non-utilized water as long as travel speeds and delay time are used to provide the same average application depth and effective field boundary. (Moore-IVI)
W84-04454

DISTRIBUTION OF IRRIGATION WATER FROM A LOW PRESSURE, LATERAL-MOVING IRRIGATION SYSTEM,
Agricultural Research Service, Fresno, CA. Water Management Research Lab.
T. A. Howell, and C. J. Phene.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 5, p 1422-1429 and 1434, September-October, 1983. 13 Fig, 3 Tab, 22 Ref.

Descriptors: *Lateral-moving irrigation systems, *Low pressure irrigation, Irrigation water, Distribution, Spray losses.

Fundamental considerations for irrigation water applications from lateral-moving irrigation systems are presented. The application dynamics are discussed relative to low-pressure, lateral-move irrigation machines. A prototype low pressure, lateral-move irrigation system was evaluated by testing several applicator systems for low volume, frequent irrigations. Results indicated that static uniformity coefficient exceeded 0.98. However, the dynamic uniformity coefficient was about 0.90. Pressurization requirements can be reduced to less than 200 kPa (possibly as low as 100 kPa) with little reduction in uniformity. The spray losses (both drift and evaporation) from the low pressure, overhead spray systems were about 10%. System alignment and, particularly, system speed control appear important to achieving uniform applications with low-pressure, lateral-moving systems. Additional research on speed control technology appears desirable. (Author's abstract)
W84-04469

SPRINKLER IRRIGATION DESIGN FOR UNIFORMITY ON SLOPES,
Hawaii Univ., Honolulu. Dept. of Agricultural Engineering.
I.-P. Wu, and H. M. Gitlin.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 6, p 1698-1703, November-December, 1983. 4 Fig, 1 Tab, 11 Ref, 1 Append.

Descriptors: *Slopes, *Sprinkler irrigation, Conveyance structures, Mathematical equations, Sprinklers.

Simple design procedures are introduced for sprinkler laterals (or submain) for uniform down slopes and non-uniform situations. The developed design chart for lateral or sub-main design on uniform down slope situations can be used to design required line size and also used for checking the acceptability of a design of the selected line size. The design requires only the line length, total discharge, operating pressure, slope and limited calculation. The pressure variation along a lateral (or submain) can be determined by combining the friction drop and energy gain (or loss) by slopes. When the number of sprinklers is 5 or more, the dimensionless energy gradient curve is close to the curve for an infinite number of outlets (sprinklers), so the dimensionless energy curve derived by assuming infinite outlets can be used to calculate friction drop pattern along the lateral or submain.

The primary object is to include slope effects in the design of sprinkler systems. (Moore-IVI)
W84-04477

COMPUTER MODEL FOR MOISTURE DISTRIBUTION IN STRATIFIED SOILS UNDER A TRICKLE SOURCE,
Clemson Univ., SC. Dept. of Agricultural Engineering.
C. F. Armstrong, and T. V. Wilson.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 6, p 1704-1709, November-December, 1983. 7 Fig, 4 Tab, 24 Ref.

Descriptors: *Trickle irrigation, *Soil water, *Computer models, Simulation, Stratified soils, Wetting front, Application rate, Permeability coefficient.

This research was conducted to: (1) develop a computer simulation model - or use an existing one - to simulate irrigation in stratified soils, (2) study the moisture distribution under a trickle source in a Lakeland sand, and (3) compare results of the computer model with field measurements. Field tests were conducted at various application rates and volumes, a CSMP model was modified for use in stratified soils, and this modified program was used to simulate irrigation in the Lakeland soil. The neutron scattering method was used to measure the moisture distribution to a depth of 150 cm and to a radius of 105 cm from the trickle emitter. For each test, measurements were made before and after irrigation and again after some redistribution period. Also, tensiometers were placed at specified depths at a radius of 45 cm to help locate the wetting front during application and redistribution. Input data for the CSMP simulation model (in-situ tension vs. water content and hydraulic conductivity vs. water content for each soil horizon) were obtained using the instantaneous profile method. Field measurements showed that the shape and size of the wetted zone is more a function of the volume of water applied than of the rate of application. When more than 32 L were applied, the additional water did not greatly increase the horizontal dimension of the wetted zone, but moved vertically through the profile. The CSMP simulation compared favorably with the field measurements in the Lakeland sand. (Author's abstract)
W84-04478

STORAGE LOSSES IN RESERVOIRS,
For primary bibliographic entry see Field 8A.
W84-04667

THE ACHIEVEMENTS OF CUBAN WATER MANAGEMENT - 20 YEARS OF WASTE MANAGEMENT IN THE REPUBLIC OF CUBA (DIE ERRUNGENSCHAFTEN DER KUBANISCHEN WASSERWIRTSCHAFT - 20 JAHRE WASSERWIRTSCHAFT IN DER REPUBLIK KUBA),
K.-H. Schroder, and J. Klein.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 3, p 93-95, March, 1983. 4 Ref.

Descriptors: *Water management, *Cuba, Water supply, Sewer systems, Irrigation, Flood control, Water conveyance, Reservoirs, Groundwater recharge.

Participants of the Conference of Heads of Water Management Agencies of COMECON member countries, which took place in Cuba in September 1982, were able to see at first hand the results of water management in Cuba and to enjoy an in-depth experience exchange concerning its future directions. True development of water management in Cuba began only after the revolution with the founding of the National Institute for Water Management in 1962. Primary goals were accelerated development of the water infrastructure and supplying of the rural and urban population with drinking water. Achievements of the past 20 yr include the supply of 60% of the population with drinking water and a sewer system serving one-third of wastewater, construction of reservoirs with a capacity of almost 6.5 billion cu m, utilization by means of reservoirs of 5.27 billion cu m of an estimated 14.7 billion cu m usable surface water, and work on a project for the artificial enrichment of groundwater to increase the estimated supply 1.1 billion cu m to 7.5 billion cu m. The area of irrigated agricultural land is to be increased from the present 1.2 million hectares to 1.75 million in 1990 and 2.23 million in the year 2000. In the area of flood control, 600 km of dams, 800 km of drainage channels, and 800 km of river regulating channels have been built. A study of chief polluters is in progress. A network of 705 measuring stations is being constructed (317 are complete) to aid in user-initiated rational water use. For the future, goals include economic regulation in water management, more even distribution of water resources, and optimization of agricultural water use through modernization of procedures and equipment. (Gish-IVI)
W84-04781

4B. Groundwater Management

NITRATE CONTAMINATION OF SUBSURFACE WATERS IN AN URBANIZING AREA,
Case Western Reserve Univ., Cleveland, OH. Dept. of Geological Sciences.
For primary bibliographic entry see Field 5B.
W84-04227

ESTIMATING 1980 GROUND-WATER PUMPAGE FOR IRRIGATION ON THE HIGH PLAINS IN PARTS OF COLORADO, KANSAS, NEBRASKA, NEW MEXICO, OKLAHOMA, SOUTH DAKOTA, TEXAS, AND WYOMING,
Geological Survey, Denver, CO. Water Resources Div.
F. J. Heimes, and R. R. Luckey.
Available from the Ofss, USGS, Lakewood, CO 80225; Price: $5.75 in paper copy, $4.50 in microfiche. USGS Water-Resources Investigation Report 83-4123, 1983. 36 p, 7 Fig, 7 Tab, 9 Ref.

Descriptors: *Water use, *Irrigation, *Consumptive use, *Remote sensing, Groundwater, Discharge measurement, Instruments, Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, Wyoming, *High Plains aquifer, Pumpage, Irrigated cropland.

Current ground-water use is required for the High Plains Regional Aquifer-System Analysis. In response to this need, a sampling approach was developed to estimate water pumped for irrigation on the High Plains during 1980. Pumpage was computed by combining application estimates with mapped irrigated-acreage information. Irrigation application (inches of water applied) was measured at 480 sites in 15 counties in the High Plains during the 1980 growing season. The relationship between calculated Blaney-Criddle irrigation demand and measured application was used to estimate application for unsampled areas of the High Plains. Application estimates multiplied by irrigated-acreate estimates, compiled from Landsat-satellite imagery, yielded the volume of ground water pumped for irrigation. The estimate of ground water pumped for irrigation in the High Plains during 1980 and 18,902,000 acre-feet for 13,715,000 irrigated areas. The sampled application data were evaluated for significant trends. The application was greater for crops requiring more water such as corn and hay and less for crops such as sorghum, grain, and cotton. The data showed greater application for flood-irrigated systems than for sprinkler-irrigation systems. Areas of the High Plains with thin saturated thickness tended to have a smaller average discharge per well, fewer irrigated acres per well, and a predominance of crops requiring less water crops. (USGS).
W84-04257

STREAMFLOW LOSSES AND CHANGES IN GROUND-WATER LEVELS ALONG THE SALE AND GILA RIVERS NEAR PHOENIX, ARIZONA - FEBRUARY 1978 TO JUNE 1980,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 4A.
W84-04264

A DIGITAL-COMPUTER MODEL OF THE BIG SIOUX AQUIFER IN MINNEHAHA COUNTY, SOUTH DAKOTA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-04271

A GROUNDWATER MODEL FOR SIMULATING THE RISE OF WATER TABLE UNDER IRRIGATED CONDITIONS,
Haryana Agricultural Univ., Hissar (India).
R. Singh, S. K. Sondhi, J. Singh, and R. Kumar.
Journal of Hydrology, Vol. 71, No. 1-2, p 165-179, March, 1984. 4 Fig, 7 Tab. 8 Ref.

Descriptors: *Water table fluctuations, *Model studies, *Irrigation practices, Farming, Water table, Pumpage, Groundwater, Lower Ghaggar Basin, Haryana, India, Canals, Irrigation canals, Drinking water, Water demand.

During the last two decades, land-use of the major portion of Ghaggar River basin in the Haryana State of India has been transformed from dry-land agriculture to irrigated farming. A groundwater simulation model is used to predict the dynamic behavior of the water table in response to groundwater pumpage and net recharge in a part of the Lower Ghaggar basin. The pumped water is proposed to be used together with canal water for irrigation of crops and for drinking water demands considering the quality constraints. The study was conducted at the Farm of Haryana Agricultural University, an area of 1300 ha, to find management practices for controlling the rising water table. (Baker-IVI)
W84-04306

MALMESBURY GROUNDWATER SCHEME,
Wessex Water Authority, Bristol (England).
For primary bibliographic entry see Field 5F.
W84-04310

BOREHOLE RECHARGE OF THE FOLKESTONE BEDS AT HARDHAM, SUSSEX, 1980-81,
Southern Water Authority, Worthing (England). Resources Section.
M. J. O'Shea.
Journal of the Institution of Water Engineers and Scientists, Vol. 38, No. 1, p 9-24, February, 1984. 9 Fig, 2 Tab, 19 Ref.

Descriptors: *Groundwater recharge, *Boreholes, *Sussex, *England, Aquifers, Water supply, Water resources development, Borehole geophysics.

The results of short-term experimentation into borehole recharge carried out by the Southern Water Authority in an abstraction/recharge borehole at Hardham pumping station are presented. The Folkestone Beds aquifer varies in thickness in the area of study from 24 to 70 m and consists of medium to fine-grained, poorly or moderately cemented quartzose sands. Borehole recharge of fully treated river water into the Folkestone Beds culminated in a month's continuous recharge at 48l/s. The dual-purpose, single-main recharge/abstraction borehole incorporated a downhole valve to control recharge rates and to prevent air entry into the aquifer. Two boreholes lined with narrow-diameter, water-filled, galvanized steel tubes were specifically constructed to detect recharge movement by temperature logging. Chemical analyses of numerous water samples, together with geophysical logging, showed the wholesale displacement of groundwater by recharge water with little or no change in water chemistry. Little evidence existed of borehole clogging although small, short-lived turbidity peaks were associated with post-recharge abstraction, with or without simultaneous backwashing through the six backwash tubes. (Baker-IVI)
W84-04317

ORGANIC CONTAMINANT BEHAVIOR DURING RAPID INFILTRATION OF SEC-

ONDARY WASTEWATER AT THE PHOENIX 23RD AVENUE PROJECT,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W84-04353

BENEFITS FROM GROUNDWATER MANAGEMENT: MAGNITUDE, SENSITIVITY AND DISTRIBUTION,
California Univ., Riverside.
E. Feinerman, and K. C. Knapp.
American Journal of Agricultural Economics, Vol. 65, No. 4, p 703-710, November, 1983. 2 Tab, 25 Ref.

Descriptors: *Groundwater management, *Benefits, *Kern County, *California, Taxes, Economic aspects, Cost-benefit analysis, Cost analysis, Irrigation, Water management.

Empirical estimates of benefits from groundwater management are reported for an area in California with heavy reliance on groundwater supplies. Benefits were quite sensitive to the water demand schedule and interest rate but less sensitive to other parameters. Either quotas or pump taxes can be used to achieve efficient groundwater withdrawals in the aggregate. However, there were dramatic differences in the distributional consequences. Groundwater users gain under quotas but suffer heavy losses under taxes. The sensitivity analysis provided alternate estimates of benefits from management in Kern County. It suggested how management benefits will change as economic and water supply conditions change. Benefits from management can be expected to increase as energy costs rise. Benefits from groundwater mangement were calculated to be $116 per irrigated acre in Kern County. This represents a 14% increase in the net benefits from groundwater use compared to no regulation and a 6% increase in the net benefits from both ground and surface water use. The relevant guideline for instituting groundwater management is that benefits exceed the costs. (Baker-IVI)
W84-04416

A SYSTEM FOR MANAGING WATER IN FINE TEXTURED SOILS,
Agricultural Research Service, Baton Rouge, LA.
C. E. Carter, J. E. Irvine, and C. R. Camp.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 3, p 767-771, May-June, 1983. 8 Fig, 7 Ref.

Descriptors: *Groundwater management, *Louisiana, *Drainage, *Subsurface irrigation, Silty clay, Silt loam, Water table, Water management, Drought, Groundwater movement, Soil texture.

A water management system, which compensates for erratic rainfall was tested on silty clay and silt loam soils in Louisiana. With monthly rainfall in the State varying from 0 to more than 375 mm and with annual average rainfall of about 1400 mm, a water management system which would drain excess water from the soil during rainy, wet periods and add water to the soil by subirrigation during droughts was needed. The system that was tested consisted of bordered areas in which subsurface drains were installed. The drains were connected to sumps equipped with pumps, valves, and switches for removing drain outflow. This same system was used for irrigation by adding water to the sumps causing the water table to rise into the root zone. The system was first tested on 40 sq m concrete bordered plots during 1967-1972 at Baton Rouge, LA, and later on 0.4 ha plastic bordered plots during 1979-1981 near Houma, LA. The success of the system was attributed to favorable water flow properties of the soil, borders which restricted the lateral movement of water to and from the bordered area, and the presence of a natural water table, usually within the top 1.2 m of the soil profile, which prevented excessive water losses due to percolation during irrigations. (Author's abstract)
W84-04439

SHALLOW SUBSURFACE DRAIN PERFORMANCE IN CLERMONT SOIL,
Agricultural Research Service, Columbia, MO.
N. R. Fausey.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 3, p 782-784, May-June, 1983. 5 Fig, 2 Tab, 2 Ref.

Descriptors: *Subsurface drainage, *Clermont soils, *Crop yield, Corn, Water table, Drawdown, Water quality.

The Clermont series consists of deep, nearly level, poorly drained soils. Subsurface drains were installed at 45 to 50 cm depth in Clermont silt loam soil with good surface drainage. The drains were 50 mm diameter corrugated plastic tubing installed on a slope of 0.33 to 0.38%. Water table elevations, drain flow rates, drain water quality and corn yields were measured over a 3-year period. Water table measurements showed the zone of drawdown occurred mostly within 3 m of the drain line although corn yields indicated an effect to about 6 m. Corn yields were increased an average of 0.85 metric tons/ha over the period by the subsurface drains. The drains removed about 28% of the rainfall during the study period. The drains showed minimal sediment accumulation, no structural deformation and the outflow water was of good quality. (Moore-IVI)
W84-04442

SUGARCANE YIELD RESPONSE TO SUBSURFACE DRAINAGE FOR AN ALLUVIAL SOIL,
Agricultural Research Service, Florence, SC.
C. R. Camp, and C. E. Carter.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 4, p 1112-1116, July-August, 1983. 3 Fig, 1 Tab, 10 Ref.

Descriptors: *Subsurface drainage, *Sugarcane, *Drainage effects, *Louisiana, Crop yield, Alluvial soils, Rainfall, Water table.

A field study was conducted on an alluvial soil in Louisiana to determine the yield response of sugarcane to various subsurface drainage treatments that included three drain spacings (6.1, 12.2, and 24.4 m) and two drain depths (0.9 and 1.4 m). Annual rainfall was above the long-term mean during one year (1975) of the three-year study and was much lower than mean annual rainfall during the other two years (1974, 1976). All subsurface drainage systems adequately controlled the water table. Sugarcane and sugar yields for the subsurface drained treatments were significantly higher than yields for the undrained treatment during the wet year (1975) when the water table in the undrained treatment was very high during much of the year. The lower yield for the undrained treatment during the wet year was due primarily to lower plant population. Although yield increases were obtained for only one year, the magnitude of the increase for that year was large enough to defray a significant portion of the system installation cost. (Author's abstract)
W84-04456

OPTIMAL ANNUAL OPERATION OF A COASTAL AQUIFER,
Technion - Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
U. Shamir, J. Bear, and A. Gamliel.
Water Resources Research, Vol. 20, No. 4, p 435-444, April, 1984. 8 Fig, 5 Tab, 10 Ref.

Descriptors: *Optimization, *Coastal aquifer, Model studies, Multiple objectives, Linear programming, Groundwater management, Israel.

Optimal annual operation of a coastal aquifer is determined by using a multiple objective linear programming model based on a multicell model of the aquifer and a network representation of the hydraulic distribution system. The decision variables are pumping and/or recharge quantities in each cell. Four objective functions are based on (1) a desired groundwater surface map, (2) a desired location of the sea water-fresh water interface toe in each coastal cell, (3) a desired concentration map of a selected conservative contaminant, and (4) minimization of the energy for pumping and recharge. An approximate linearized expression of the location of the interface has been developed to enable the use of linear programming as the optimization method. A trade-off procedure is employed for identifying the most desirable solution. The model is applied to a segment of the coastal aquifer in Israel (a 44-km strip along the coast with a width of 7 to 15 km) and results are discussed. The operation is very tightly constrained for the presently existing wells and hydraulic system. Therefore the multiple objective decisionmaking process is rather limited in scope; after one round of single objective optimizations a final (compromise) solution can be selected. (Murphy-IVI)
W84-04567

EDV-SUPPORTED CALCULATION OF GROUNDWATER DRILLING INSTALLATIONS WITH THE GROUNDWATER DRILLING PROGRAM PACKAGE - PART 2 (EDV-GESTUTZTE BERECHNUNG VON GRUNDWASSERABSENKUNGSANFAGEN MIT DEM PROGRAMMPAKET GRUNDWASSERABSENKUNG - TEIL 2),
Ingenieurhochschule Cottbus (German, D.R.). Sektion Technologie der Bauproduktion.
For primary bibliographic entry see Field 8A.
W84-04783

4C. Effects On Water Of Man's Non-Water Activities

HYDROLOGY AND SUBSIDENCE POTENTIAL OF PROPOSED COAL-LEASE TRACTS IN DELTA COUNTY, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
T. Brooks.
USGS Water-Resources Investigations Report 83-4069, 1983. 27 p, 5 Fig, 4 Tab, 22 Ref.

Descriptors: Hydrologic data collections, Water-quality data collections, *Subsidence, Aquifer characteristics, *Aquifers, Perched aquifers, Unconsolidated aquifers, *Coal mining, Data, *Springs, Streams, *Wells, Mesaverde Formation, North Fork Gunnison River valley, Gunnison River drainage, Delta County, *Colorado.

Potential subsidence from underground coal mining and associated hydrologic impacts were investigated at two coal-lease tracts in Delta County, Colorado. Alteration of existing flow systems could affect water users in the surrounding area. The Mesaverde Formation transmits little ground water because of the neglibile transmissivity of the 1,300 feet of fine-grained sandstone, coal, and shale comprising the formation. The transmissivities of coal beds within the lower Mesaverde Formation ranged from 1.5 to 16.7 feet squared per day, and the transmissivity of the upper Mesaverde Formation, based on a single test, was 0.33 foot squared per day. Transmissivities of the alluvium ranged from 108 to 230 feet squared per day. The transmissivity of unconsolidated Quaternary deposits, determined from an aquifer test, was about 1,900 feet squared per day. Mining beneath Stevens Gulch and East Roatcap Creek could produce surface expressions of subsidence. Subsidence fractures could partly drain alluvial valley aquifers or streamflow in these mines. (USGS)
W84-04262

INFILTRATION THROUGH RECONSTRUCTED SURFACE MINED SPOILS AND SOILS,
Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
A. D. Ward, L. G. Wells, and R. E. Phillips.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 3, p 821-830 and 832, May-June, 1983. 10 Fig, 1 Tab, 5 Ref.

Descriptors: *Strip mine wastes, *Land reclamation, *Infiltration, *Kentucky, Topsoil, Spoil banks, Mine wastes, Soil water, Soil texture, Density, Rainfall rate.

An extensive series of tests involving reconstructed profiles of spoil and topsoil material from a Western Kentucky surface mine site was conducted with a laboratory infiltrometer system. Infiltration through the reconstructed spoil profiles was very low despite the coarse nature of the material. Low infiltration rates could be attributed to the material having a well-graded texture and to the high densities of the profiles. Infiltration through topsoil horizons was controlled, for the most part, by conditions at the surface. Following wetting, infiltration rates were primarily controlled by the hydraulic characteristics of the less permeable subhorizon of the spoil material. Except in very early stages, rainfall rate had little effect upon infiltration rate (or volume) through the spoil and topsoil profiles. Infiltration was, however, significantly influenced by initial moisture content and density. (Author's abstract)
W84-04445

4D. Watershed Protection

SOIL CONSERVATION WITH UNCERTAIN REVENUES AND INPUT SUPPLIES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Economics.
R. A. Kramer, W. T. McSweeny, and R. W. Stavros.
American Journal of Agricultural Economics, Vol. 65, No. 4, p 694-702, November, 1983. 4 Tab, 29 Ref.

Descriptors: *Soil conservation, *Decision making, *Economic aspects, Risk analysis, Model studies, Nonpoint pollution sources, Water pollution control, Soil erosion.

Annual soil loss in the United States due to sheet and rill erosion exceeds two billion tons annually. A major portion of the loss comes from agricultural and forest lands, contributing to the nonpoint source pollution of the nation's waterways and depleting the productive capacity of the land. The influence of risk on farm level soil conservation decisions is examined. A symmetric quadratic risk-programming model is used which allows the simultaneous consideration of uncertainty in revenues and input supplies. The generalized mean-variance model can be applied in realistic setting by means of symmetric quadratic programming. Compared to the more conventional quadratic risk-programming formulation, symmetric quadratic programming allows the conservation of an additional element of risk: uncertain limiting resources. Initially the model was solved without restrictions on soil loss. When regulatory constraints on erosion were analyzed it was determined that even a 25% reduction in soil loss generated substantial cuts in income. Risk aversion can influence the selection of soil conserving activities. (Baker-IVI)
W84-04415

PROTECTION OF SOILS FROM EROSION THROUGH STRIP CROPPING,
Ye. V. Poluektov.
Soviet Soil Science, Vol. 15, No. 1, p 79-85, 1983. 7 Tab, 7 Ref. Translated from Pochvovedeniye, No. 2, p 111-117, 1983.

Descriptors: *Erosion control, *Soil water, *Strip cropping, Erosion, Vegetation, Seasonal variation, Meltwater, Storm runoff, Wheat, Grass, Soil physical properties.

Factors were studied which retard the flow of meltwater and stormwater in strips of various crops in the northern part of the Azov Chernozem region. The area investigated has broken terrain with weighted-average slopes of 2.0 degrees. The depth of local base level of erosion is about 100 m. Snowcover at the end of the winter season is 8-15 cm deep. Water about 60 mm deep flows when the snow melts in the spring. Irregular compaction of plowed land during plowing and sowing of winter crops causes the amount of melt water runoff to vary. While flow generated in belts of winter wheat and perennial grasses is weak, it is almost absent from friable plowed land. The higher permeability of soils in plowed strips completely or partially retards and absorbs flow entering from compacted soil. During the summer the vegetative cover in strips having dense crop cover and the diversity of hydrophysical characteristics of soils in the strips, serve to retain flow originating from rainstorms. When a dense cover of plants decreases the runoff rate, the soil is improved by deposited material brought from fallow or tilled land on higher strips. More effective hydrophysical properties of the soil in combination with a dense network of cracks permit absorption of a significant quantity of water. (Baker-IVI)
W84-04518

MOISTURE AND SALT TRANSFER PROCESSES DURING MULCHING OF BARE FALLOW,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
S. M. Pakshina.
Soviet Soil Science, Vol. 15, No. 1, p 113-120, 1983. 2 Fig, 1 Tab, 13 Ref. Translated from Pochvovedeniye, No. 2, p 85-92, 1983.

Descriptors: *Soil water, *Mulching, Evaporation, Erosion control, Leaching, Salts, Nutrients, Droughts, Fallowing, Calcium, Hydrogen ion concentration.

The mechanism of moisture, salt and nutrient transfer processes were examined in a leached Chernozem mulched with straw or hydrophobic soil. Quantitative assessments were made of vapor and liquid moisture flows during evaporation. The following features became clear during moisture evaporation from mulched soil. First, evaporation losses of soil moisture are determined in the first stage mainly by liquid flow of moisture. Secondly, from the moment the soil under mulch dries and a dried layer is formed, evaporation is determined by vapor flows under the action of temperature gradients during the night time and relative humidity gradients in the soil air. The optimization of microbiological proceses during mulching affected the chemical composition of the soil. The pH level decreased and nitrate concentration and solubility of calcium carbonate increased. This makes it very important to mulch Solonchaks and Solonetz-like soils. Mulching not only mitigates the severity of droughts by preserving soil moisture but also speeds up reclamation of these soils by decreasing the pH and increasing mobile calcium ions. (Baker-IVI)
W84-04519

EXPERIENCES IN THE INTEGRATION OF WATER MANAGEMENT FACILITIES INTO THE LANDSCAPE USING TREES (ERFAHRUNGEN BEI DER EINBINDUNG WASSERWIRTSCHAFTLICHER ANLAGEN),
Wasserwirtschaftsdirektion Obere Elbe-Neibe (German, D.R.).
H. Eisenreich.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 4, p 126-129, April, 1983.

Descriptors: *Landscaping, *Trees, *Water treatment facilities, *Wastewater treatment facilities, Bushes, Dams, Watersheds, Cost analysis, Water management, Buildings.

Large water-management structures such as dams and their service buildings, waterworks, and wastewater treatment facilities are usually foreign bodies in an organic landscape and often change it drastically. In order to lessen these effects, it is necessary not only for afforestation in dam catchment areas but also to plant trees and bushes to integrate the buildings themselves with the landscape. This has the added advantage of replacing cost- and maintenance-intensive lawns and flower beds with cheap and care-free shrubbery. Suitable species are suggested. In 1971 and 1972, the forestry engineer of a German Democratic Republic Water Management Area inspected various facilities in his area and made suggestions for planting. Two to three years later, it was determined that the suggestions had not always been followed, and some large trees that were too near buildings had to be removed (these obscure the view of facilities that must be observed). The planting of firs on the downstream side of a dam is described; in this case it was planned to use some of the trees for lumber after 12-15 years. Maintenance-free pasture can also be used in a case like this. To keep maintenance to a minimum, fast-growing species should be chosen, which quickly cover the ground. It is cheaper to plant fast-spreading species further apart despite higher maintenance costs than to plant them closer together, when costs for planting and soil preparation are high. Costs for a lawn are 160-310 Marks/100 sq m, whereas those for trees and bushes are 35-408 Marks/100 sq m. When new facilities are designed, plans for planting should be included. (Gish-IVI)
W84-04789

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

DETERMINATION OF METHYLGERMANIUM SPECIES IN NATURAL WATERS BY GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROMETRY WITH HYDRIDE GENERATION,
Florida State Univ., Tallahassee. Dept. of Oceanography.
G. A. Hambrick, III, P. N. Froelich, Jr., M. O. Andreae, and B. L. Lewis.
Analytical Chemistry, Vol. 56, No. 3, p 421-424, March, 1984. 4 Fig, 2 Tab, 13 Ref.

Descriptors: *Methylgermanium, *Natural waters, *Atomic absorption spectrometry, Chemical properties, Optimization.

Inorganic and methylgermanium species are determined in aqueous matrix at the parts-per-trillion level by a combination of hydride generation, graphite furnance atomization, and atomic absorption spectrometry. The germanium species are reduced by sodium borohydride to the corresponding gaseous germanes and methylgermanium hydrides, stripped from solution by a helium gas stream, and collected in a liquid-nitrogen-cooled trap. The germanes are released by rapid heating of the trap and enter a modified graphite furnace at 2700 degrees C. The atomic absorption peak is recorded and electronically integrated. The absolute detection limits are 155 pg of Ge for inorganic germanium (Ge1), 120 pg of Ge for monomethylgermanium (MMGe), 175 pg of Ge for dimethylgermanium (DMGe), and 75 pg of Ge for trimethylgermanium (TMGe). The precision of the determination ranges from 6% for TMGe to 16% for MMGe. Results of the analyses of natural waters are presented. (Author's abstract)
W84-04194

LIQUID CHROMATOGRAPHIC DETERMINATION OF AMMONIUM IN WATER,
Nara Prefectural Inst. of Public Works (Japan).
M. Mizobuchi, K. Tamase, Y. Kitada, M. Sasaki, and K. Tanigawa.
Analytical Chemistry, Vol. 56, No. 3, p 603-605, March, 1984. 2 Fig, 3 Tab, 18 Ref.

Descriptors: *Pollutant identification, *Ammonia, Water analysis, Wastewater analysis, Chromatography, High performance liquid chromatography, Ammonium fluorophor.

A method is described for the the determination of ammonium in environmental water samples by high performance liquid chromatography (HPLC) for the separation of the ammonium fluorophor from others. A total of 106 samples of river water, 20 effluents from wastewater treatment facilities and 16 rainwater samples were collected. All samples were filtered through acetylcellulose membranes. Up to 1.0 mL of the filtered sample was placed in a 10 mL test tube and made up to 2.0 mL with 0.2M borate buffer solution. Two hundred microliters of fluorescamine solution was added and the solution mixed vigorously for 20-30 sec until the color changed from white to light yellow. This solution was used for the analysis of ammoni-

um fluorophor by HPLC. A sample ranging from 5 to 20 microL was injected into the HPLC system. The concentration of ammonium was determined from the peak height by comparison to standards which were run throughout the procedure. The standard curve was linear in the concentration range of 0.2-5.0 micro g NH4(+)/2.2 mL. (Baker-IVI)
W84-04195

APPLICATION OF HENRIKSEN'S 'ACIDIFICATION INDICATOR' AND 'PREDICTOR NOMOGRAPH' TO TWO ADIRONDACK LAKES,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
M. R. Church, and J. N. Galloway.
Water, Air and Soil Pollution, Vol. 22, No. 2, p 111-120, 1984. 3 Fig, 1 Tab, 22 Ref. Electrical Power Research Institute (EPRI) contract RP1109-5.

Descriptors: *Henriksen's Acidification Indicator, *Henriksen's Predictor Nomograph, *Lakes, *Adirondacks, Hydrogen ion concentration, Acidic rain, Environmental effects, Indicators, Input-output analysis, Chemical properties, Measuring instruments, Woods Lake, Panther Lake, Sagamore Lake.

During the period 1977--1980 the effects of highly acidic precipitation (mean pH 4.1 to 4.2) on the chemistry of three Adirondack lakes (Woods Lake, Panther Lake, and Sagamore Lake) were studied. Two of these lakes (Woods and Panther) are enough like those lakes of southern Sweden and Norway studied by Henriksen that they should constitute a valid test for his 'acidification indicator' and 'predictor nomograph'. Weekly samples were taken near the surface of the lakes during unstratified summer and fall conditions over a 3 yr period. The acidification indicator and predictor nomograph were developed using data from lake samples taken under similar conditions in Scandinavia. The principal finding is that with regard to the empirical line of the acidification indicator (that Henriksen found separated data from lakes receiving precipitation greater or less than pH 4.6) and with the precipitation pH axis of the predictor nomograph, these two methods of evaluation are not directly applicable 'as is' to Adirondack lakes. The reason for this is that the chemistry of precipitation in the Adirondacks is significantly different from (and for) which the acidification indicator and predictor nomograph were developed. In the Adirondacks, acids other than H2SO4 play a much greater role in the overall acidity of the precipitation. This causes relationships between precipitation pH and lake chemistry in the two regions to be different. (Murphy-IVI)
W84-04208

CONTINUOUS MEASUREMENT OF RADON EMANATIONS FROM SOIL AND GROUNDWATERS IN SOUTHERN FRANCE (ALPES MARITIMES). PRELIMINARY RESULTS (MESURE CONTINUE DES VARIATIONS DES EMANATIONS SOUTERRAINES DU RADON SUR TROIS SITES DES ALPES-MARITIMES (FRANCE). RESULTATS PRELIMINAIRES),
A. Oddou, L. Nault, R. Campredon, and M. Bernat.
Comptes Rendus Hebdomadaires, Seances Academie/Sciences Series II, Vol. 296, No. 14, p 1081-1086, April, 1983. 7 Fig, 17 Ref.

Descriptors: *Radon, *Soil chemistry, *Groundwater, *France, *Alpes-Maritimes, Measuring instruments, Performance evaluation, Ions, Ion transport, Trace levels.

Two types of automated instruments which monitor the emission of Radon from rocks and groundwaters are actually being set up in a few localities of the French-Italian Alpes-Maritimes (SE France). The first results obtained concerning the Alpes Maritimes confirm the reliability of the recorders with continuous alpha traces but the fact that the time period involved was short doesn't permit definitive conclusions to be made nor sound correlations to be established. It was not possible to determine the influence of the atmospheric, lithologic and structural parameters of Radon in the soil. Two types of detectors, the ionization chamber and the trace recorder, continuously measure the variations of Rn 222 in a natural environment permitting the study of all possible modes of transport of this gaseous fluid in the heart of geologic formations. Therefore, the combined use of these measuring instruments is necessary in order to exploit the major seismotectonic sites of a region. (Murphy-IVI)
W84-04285

VIROLOGICAL EXAMINATION OF DRINKING WATER: A CANADIAN COLLABORATIVE STUDY,
Institut Armand-Frappier, Laval (Quebec). Centre de Recherche en Virologie.
P. Payment, M. Trudel, S. A. Sattar, V. S. Springthorpe, and T. P. Subrahmanyan.
Canadian Journal of Microbiology, Vol. 30, No. 1, p 105-112, January, 1984. 4 Tab, 24 Ref. Health and Welfare Canada grant 6606-1781-54, 6605-1649-54, 6606-1790-54.

Descriptors: *Virology, *Drinking water, *Canada, Wastewater analysis, Microscopic analysis, Reoviruses, Picornaviruses, Viruses, Water quality standards, Bacterial analysis, Turbidity, Residual chlorine, Montreal, Ottawa, Toronto.

A collaborative virological survey of drinking water was initiated in three major Canadian urban areas, Montreal, Ottawa, and Toronto. In each selected area, three water purification plants were sampled monthly for up to 18 months. The total population served by all nine plants was about 1,500,000. Samples of raw (100 L) and treated (1000 L) water were examined by virus concentration procedures based on adsorption-elution. Sample concentrates were assayed for cytopathic viruses on BS-C-1 cells and the results were expressed as the most probable number of cytopathic units (MPNCU). Viruses were detected in 57% (0-15.35 MPNCU/L) of the raw water samples from Montreal, 37% (0-46.0 MPNCU/L) in Ottawa, and 33% (0-4.91 MPNCU/L) in Toronto. The majority of isolates were reoviruses, but picornaviruses were also found. All finished waters (177 samples) met bacteriological, turbidity, and residual chlorine standards and were free of detectable viruses. (Author's abstract)
W84-04287

BUTYLTIN COMPOUNDS AND INORGANIC TIN IN SEDIMENTS IN ONTARIO,
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
R. J. Maguire.
Environmental Science Technology, Vol. 18, No. 4, p 291-294, 1984. 4 Tab, 18 Ref.

Descriptors: *Butyltin, *Inorganic tin, *Sediments, *Ontario, Measuring instruments, Organotin compounds, tri-n-Butylmethyltin, di-n-Butyldimethyltin.

Organotin compounds are used as stabilizers for polyvinyl chloride, as catalysts, and as biocides. The increasing annual use of organotin compounds raises the possibility of environmental pollution. A method has been developed for the analysis of butyltin species and in organic tin in sediments, and the presence of these compounds in sediments in Ontario is reported for the first time. Although inorganic tin occurred frequently in sediments collected around the province, butyltin species were found mainly in the sediments of harbors, reflecting earlier findings on their occurrence in water, with which these findings are compared. Tri-n-butyltin, the most toxic of the butyltin species to aquatic life, was present at 0.5 mg/kg (dry weight) in the top 2 cm of sediment in Toronto Harbor. In addition, tri-n-butylmethyltin and di-n-butyldimethyltin were found in the sediment of a few harbors, indicating that some butyltin species can be methylated in aquatic environments. (Murphy-IVI)
W84-04292

HIGH-PERFORMANCE LIQUID CHROMATOGRAPHIC DETERMINATION OF BROMOXYNIL OCTANOATE AND METRIBUZIN IN RUNOFF WATER FROM WHEAT FIELDS,
Agricultural Research Service, Beltsville, MD. Yakima Agricultural Research Lab.
D. F. Brown, L. M. McDonough, D. K. McCool, and R. I. Papendick.
Journal of Agricultural Food Chemistry, Vol. 32, No. 2, p 195-200, March-April, 1984. 3 Fig, 6 Tab, 13 Ref.

Descriptors: *High-performance liquid chromatography, *Chromatography, *Bromoxynil octanoate, *Metribuzin, *Wheat, *Agricultural Runoff, Herbicides, Measuring instruments.

A method for the direct determination of the herbicides metribuzin and bromoxynil octanoate and their metabolites DADK and bromoxynil by high-performance liquid chromatography (HPLC) was developed. Aqueous samples were frozen to simulate storage of field samples, thawed in a microwave oven to minimize time of exposure to room temperatures, acidified to pH 3.3, and extracted with dichloromethane/acetonitrile. Compounds were separated by HPLC on an octadecyl reverse-phase column with a water/methanol gradient and determined with a variable-wavelength ultraviolet detector. High-density polyethylene storage containers adsorbed 50-80% of the bromoxynil octanoate from solution, but satisfactory recoveries were obtained by extracting the freshly emptied containers with dichloromethane. In the range of 20-200 ppb, recoveries averaged 83-96%. At 25 ppb standard deviations were 4.8% form metribuzin, 4.0% for DADK, 6.2% for bromoxynil octanoate, and 1.4% for bromoxynil. Almost complete loss of bromoxynil octanoate occurred at room temperatures (20-25 degrees C) within 72 h, although no losses of the other three compounds were observed. Samples could be stored safely at -15 degrees C up to 300 days. (Author's abstract)
W84-04294

THE DETERMINATION OF LEAD AND CADMIUM BY ELECTROTHERMAL ATOMIZATION ATOMIC ABSORPTION UTILIZING THE L'VOV PLATFORM AND MATRIX MODIFICATION,
W. K. Oliver, S. Reeve, K. Hammond, and F. B. Basketter.
Journal of the Institution of Water Engineers and Scientists, Vol. 37, No. 5, p 460-470, October, 1983. 6 Fig, 5 Tab, 12 Ref.

Descriptors: *Pollutant identification, *Atomic absorption spectroscopy, *L'vov platform, Cadmium, Lead, Spectroscopy.

In monitoring potable waters for compliance with EEC Drinking Water Directives it is necessary to analyze for lead and cadmium using methods with detection limits of 5 and 0.5 microg/l, respectively. There is a need for a method with minimal bias and much more sensitivity than direct flame atomic absorption spectrophotometry; a nonflame technique with minimal sample preparation has obvious advantages. An approach is illustrated for critically evaluating the behavior of the L'vov platform and the normal tube in non-flame atomic absorption spectrophotometry. The importance of optimizing individual instruments is emphasized and the procedures for the optimization of instrumental parameters are discussed. The use of a matrix modifier was needed for a wide range of sample types. The L'vov platform with phosphoric acid as the matrix modifier provides suitable methods. The limits of detection were 2.0 and 0.125 microg/l for lead and cadmium, respectively. Spiking recoveries were between 95 and 105% at 25 and 2 micrograms/l lead and cadmium, respectively. (Baker-IVI)
W84-04312

MONITORING TECHNIQUES FOR THE ORGANIC QUALITY OF WATER,
R. A. Hyde, D. J. Rodman, and T. F. Zabel.
Journal of the Institution of Water Engineers and Scientists, Vol. 38, No. 1, p 25-38, February, 1984. 5 Fig, 4 Tab, 28 Ref.

Descriptors: *Monitoring techniques, *Water quality, *Organic compounds, Measuring instruments, Gas chromatography, Liquid chromatography, Review.

A review of the monitoring techniques available to the water industry for the control of organic chemicals in drinking water and the limitations of these methods is presented. As the cost of organics monitoring and control is high, the paper stresses the need to define clearly the objectives of the organics control strategy and to select the appropriate monitoring program to meet these objectives. The measurement of individual organic compounds such as trihalomethanes, group parameters such as total organic carbon, and the more advanced techniques using gas chromatography-mass spectrometry and high performance liquid chromatography is discussed. Microbiological techniques available for evaluating organic contaminants in drinking water, including mutagenic screening and ATP measurement are also outlined. (Murphy-IVI)
W84-04318

SEVERN ESTUARY - AN APPRAISAL OF WATER QUALITY,
Welsh Water Authority, Powys (Wales). Directorate of Scientific Services.
M. Owens.
Marine Pollution Bulletin, Vol. 15, No. 2, p 41-47, February, 1984. 1 Fig, 5 Tab, 15 Ref.

Descriptors: *Water quality control, *Severn Estuary, *England, Municipal wastewater, Dissolved oxygen, Nitrogen, Silicates, Suspended solids, Metals, Industrial wastes, Fisheries, Planning, Standards, Nutrients.

The Severn estuary is used extensively for effluent disposal. A program to establish the quantities of contaminants discharged to or entering the estuary was conducted in two phases: Phase 1 was a limited study, between June 1975 and March 1977, to provide estimates of the loads of various contaminants entering the estuary; Phase 2, between August 1977 and March 1979, more intensively the major inputs. Samples of river water and domestic and industrial effluents were analyzed for ammonia, silicate, orthophosphate, nitrite, total oxidized nitrogen, suspended solids, cadmium, copper, iron, lead, manganese, nickel, zinc, mercury, biochemical oxygen demand, particulate organic matter and dissolved organic matter. The data on chromium are incomplete because the chromium content of river waters was not determined. Water quality standard guidelines have been adopted for the main water body of the Severn Estuary. The Working Party determined that the standards should be based on the most sensitive uses of the estuary which included the maintenance and improvement of migratory fisheries and the protection of indigenous demersal fisheries and shellfisheries. Therefore the Severn Estuary Joint Committee has adopted as a policy that there should be no deterioration in overall water quality in the estuary. Since the evidence indicates that the existing concentrations of contaminants have not had any adverse effects, the standards as accepted are based on existing concentrations. (Baker-IVI)
W84-04332

COMPARATIVE STUDY OF THE CD, CU AND PB DETERMINATION BY AAS AND BY ICP-AES IN RIVER WATER; APPLICATION TO A MEDITERRANEAN RIVER (CONGOST RIVER, CATALONIA, SPAIN),
Barcelona Univ. (Spain). Dept. of Analytical Chemistry.
R. Rubio, J. Huguet, and G. Rauret.
Water Resources, Vol. 18, No. 4, p 423-428, 1984. 3 Fig, 6 Tab, 15 Ref.

Descriptors: *Spectrometry, *Atomic absorption spectrometry, *Heavy metals, *Congost River, *Spain, Pollutant identification, Cadmium, Copper, Lead, Trace elements.

The standard method for heavy metal determination in surface waters is based on atomic absorption spectrometry (AAS) measurements with a previous extraction with ammonium pyrrolidine dithiocarbamate-methyl isobutyl-ketone (APDC-MIBK) system. The inductively coupled plasma-atomic emission spectrometry (ICP-AES) technique is one of the best for trace element analysis in water due to the great sensitivity, selectivity, and minimum sample preparation work. The accuracy, precision, detection limit and rapidity in the determination of Cd, Cu and Pb in river water by AAS determination, previous extraction with APDC-MIBK system, is compared with direct determination method ICP-AES. Both methods show a similar detection limit and an analogous accuracy by the addition standard method. With a calibration curve only ICP-AES presents good accuracy. This technique is advantageous in long term precision and requires minimum sample preparation. Both methods are applied to the determination of Cd, Cu and Pb in Congost river water. In spite of the fact that the flow is low and the area is highly industrialized, all results are below the limits set by the Spanish standards on quality of surface water. The results obtained by the two methods are in disagreement, but they are acceptable considering that the values are near the detection limits and the great quantities of organic mattter present. (Moore-IVI)
W84-04350

FACTOR INTERACTIONS AND AQUATIC TOXICITY TESTING,
R. A. Voyer, and J. F. Heltshe.
Water Resources, Vol. 18, No. 4, p 441-447, 1984. 4 Fig, 2 Tab, 19 Ref.

Descriptors: *Toxicity, *Metals, *Interactions, *Aquatic animals, Water pollution effects, Model studies, Experimental design.

It is hypothesized that experimental variables constituting an exposure situation act independently when in combination. Two published data sets dealing with effects of metal mixtures on aquatic animals were reviewed in order to assess the potential practical significance of factor interactions and their implication to the design of aquatic toxicity tests. The data sets were re-analyzed using each of the following predictive models: simple-additive; linear-additive; and quadratic response. The relative effectiveness of each model in predicting joint effects of independent test variables was evaluated in terms of calculated mean-square error and goodness-of-fit (R2) values, as well as by how well predicted treatment effects compared with responses by original investigators. Analyses show that in one case all three models provided similar estimates that closely approximated observed responses, despite the presence of a statistically significant two-factor metal interaction. In the second instance, the quadratic response model effective predictor and was appreciably better than the linear-additive model in terms of the calculated parameters. The simple-additive model on the other hand, tended to over-estimate treatment effects, by as much as 80% in some instances, and was least effective of the three models examined. The working hypothesis is rejected, i.e. an assumption of factor independence is not to be accepted a priori. The presence of other possible lethal agents, together with those environmental parameters that may influence the chemistry of these agents and the physiology of test organisms need to be considered in designing test protocols. A sequential testing protocol should be used to evaluate the existence of factor interactions. (Moore-IVI)
W84-04351

CHIRONOMID DEFORMITIES AS INDICATORS OF POLLUTION FROM A SYNTHETIC, COAL-DERIVED OIL,
Oak Ridge National Lab., TN. Environmental Sciences Div.
R. M. Cushman.
Freshwater Biology, Vol. 14, No. 2, p 179-182, April, 1984. 1 Fig, 1 Tab, 13 Ref.

Descriptors: *Bioindicators, *Pollutant identification, *Chironomids, *Oil, Coal, Fuels, Coal liquid, Monitoring, Larvae, Toxicity, Teratogenicity.

If synthetic liquid fuels from coal become a commercial reality, then transportation and storage of these products will result in spills to freshwater habitats and consequent exposure of aquatic organisms. Larval Chironomus decorus (Diptera: Chironomidae), taken from experimental ponds to which a coal liquid had been added, were found to have deformities of the mentum. The percent occurrence of all deformities ranged from 2.7 to 4.6%, with an overall mean of 3.3%. Percent occurrence was independent of dose, although the highest percent occurrence was observed at the high dose. However, the percent occurrence of medial deformities, while only 1.9% at the high dose, was related to dose. Even so, the efficacy of using medial deformities as monitors for pollution by coal liquids is questionable. Traditional measures of toxicity to the benthic insect community may be more effective than the occurrence of deformities as an indicator of coal liquid contamination. (Baker-IVI)
W84-04373

2,2'-DIAMINODIETHYLAMINE CELLULOSE POWDER FOR TRACE METAL PRECONCENTRATIONS FROM WATER,
Antwerp Univ., Wilrijk (Belgium). Dept. of Chemistry.
G. Reggers, and R. Van Grieken.
Fresenius's Zeitschrift fur Analytische Chemie, Vol. 317, No. 5, p 520-526, March, 1984. 1 Fig, 5 Tab, 19 Ref.

Descriptors: *Water analysis, *Pollutant identification, Preconcentration, 2,2'Diaminodiethylamine cellulose powder, Cellulose powder.

Cellulose powder with 2,2'-diaminodiethylamine (DEN) functional groups exhibits efficient complexation of transition metal cations. Collection yields above 85% are obtained up to a chelation capacity of 1.5 meq per gram. The cellulose-DEN powder is insensitive to abundant substances like alkali and alkaline earth ions, and humic matter. Some cations can be eluted efficiently in a small volume of HNO3. Compared to preconcentration by filtration through cellulose-DEN filters, the use of cellulose-DEN powder offers higher chelation capacities, hence potentially higher enrichment factors in combination with, for example, neutron activation analysis. Since re-elution of the collected trace elements with small volumes of acids seems practical for selected elements only, the use of this preconcentration technique with flame atomic absorption analysis can be used for a number of elements but, for multielement analysis, the procedure is not promising. (Baker-IVI)
W84-04375

EXPERIENCE IN MONITORING DOMESTIC WATER SOURCES AND PROCESS WATERS FOR TRACE ORGANICS,
South Dakota School of Mines and Technology, Rapid City. Dept. of Civil Engineering.
J. S. Zogorski.
Journal of Environmental Science and Health, Vol. A19, No. 2, p 233-249, February, 1984. 2 Fig, 4 Tab, 18 Ref.

Descriptors: *Monitoring, *Organic compounds, *Drinking water, Water supply, Quality control, Gas chromatography.

A strategy is presented for monitoring municipal drinking water sources, process waters, and distribution waters for the presence of selected organic compounds, both volatile and non-volatile. The monitoring strategy and associated analytical procedures evolved in conjunction with organic monitoring investigations for several cities in Indiana and Kentucky. The interest in monitoring water supplies and finished waters by water utilities evolved from a relatively narrow focus of detecting for volatile organic compounds (trihalomethanes) to a very broad task of determining the identity and concentration of hundreds of individual organic compounds of an industrial origin. A brief description is offered for the gas chromatographic methods used to measure to presence of indicator organic compounds. The heavy reliance on gas chromatography in completing the approach has resulted in considerable cost savings to

municipalities while still meeting various monitoring needs, in comparison to total reliance on GC/MS testing. This procedure may be especially useful to water utilities who are just commencing the difficult task of collecting information about organic contaminants that may be present in their water supply and drinking waters. The approach is predicated on the assumption that a subset of indicator compounds can provide a representative picture of the overall organic contamination situation for a particular utility. (Baker-IVI)
W84-04387

HEAVY METAL CONTENT AND LITHOLOGICAL PROPERTIES OF RECENT SEDIMENTS IN THE NORTHERN ADRIATIC,
Venice Univ. (Italy). Facolta di Chimica Industriale.
R. Donazzolo, O. H. Merlin, L. M. Vitturi, and B. Pavoni.
Marine Pollution Bulletin, Vol. 15, No. 3, p 93-101, March, 1984. 9 Fig, 3 Tab, 10 Ref.

Descriptors: *Heavy metals, *Sediments, *Seawater, Adriatic Sea, Mercury, Lead, Cadmium, Copper, Chromium, Nickel, Cobalt, Zinc, Iron.

Heavy metal concentrations, textural characters and mineralogical compositions have been determined on 246 surface sediment samples from the Northern Adriatic Italian sea area. The relationship between the heavy metals content and the pelite percentage has been studied. Comparing relationships between heavy metals contents and some properties of sediments such as fine fraction composition, specific surface area and accumulation level in the pelite, some elements (Hg, Cu, Ni, and Fe) showed a fairly good similar degree of correlation with all these variables. Others (Cr, Zn, Pb, and Cd) even though accumulated in the fine fraction, do not have a good correlation with pelite and specific surface area. Cobalt has a low accumulation in the fine fraction, no significant correlation with the pelite and poor correlation with the specific surface area. (Baker-IVI)
W84-04394

MEASUREMENTS OF THE CONCENTRATION IN RAINWATER AND OF THE HENRY'S LAW CONSTANT OF HYDROGEN PEROXIDE,
Tokyo Metropolitan Research Inst. for Environmental Protection (Japan).
K. Yoshizumi, K. Aoki, I. Nouchi, T. Kobayashi, and S. Kamakura.
Atmospheric Environment, Vol. 18, No. 2, p 395-401, 1984. 9 Fig, 3 Tab, 62 Ref.

Descriptors: *Rainwater, *Henry's Law Constant, *Hydrogen peroxide, *Measuring instruments, Chemistry of precipitation, Chemical properties, Air pollution, Tokyo, Japan.

Recently H2O2 has been of great concern as a termination reaction product of hydroperoxyl radical in photochemical chain reactions in the atmosphere. In addition, the reaction of S(IV) with H2O2 in rainwater has been considered to be a major process by which atmospheric SO2 is converted to sulfate. A chemiluminescent method for measuring hydrogen peroxide was developed using hemin as a catalyst for luminol-based H2O2 oxidation, which gave a detection limit below 0.1 microg/l in the solution. The most atmospheric species did not give serious interference, and that negative interference of SO2 could be eliminated if pH of the collecting solution was above 10 whereas O3 gave significant positive interference. The Henry's law constant of H2O2 was experimentally determined to be 1.42 x 105 M/atm at 20 degrees C at ambient concentration levels of H2O2. This method was also applied to the measurements of H2O2 concentration in rainwater in Tokyo, Japan, which was in the range of 5-1065 microg/l. (Murphy-IVI)
W84-04537

IN VITRO CHOLINESTERASE INHIBITION OF ORGANIC MATTER IN URBAN AND RURAL RIVER SEDIMENT,
Science Univ. of Tokyo. (Japan). Faculty of Pharmaceutical Sciences.
M. Tabata, E. Bannai, H. Nishizono, and S. Suzuki.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 1, p 391-399, April, 1984. 4 Fig, 3 Tab, 8 Ref.

Descriptors: *Sediments, *Cholinesterase inhibition, *Pollutant identification, *Japan, Rivers, Urban areas, Organic matter.

The inhibitory effect of solvent extracts of urban and rural river sediment on cholinesterase in vitro was examined. Sediment samples were collected from the surface layer in five urban rivers (the Tsurumi, Meguro, Sumida, Ara, and Ayase Rivers), and five rural rivers which run through the paddy field region near Kujukuri beach. Sediments were dried and the samples obtained were extracted twice every 8 hr with a mixture of n-hexane (Hex) and distilled water. Next they were extracted using ethyl acetate and distilled water and then methanol. Dose response curves of cholinesterase inhibition of urban or rural river extracts are shown. The inhibitory effect on ChE of each extract was weak. The Hex extracts showed the weakest effect. It is apparent that each extract inhibited ChE, because ChE inhibition increased as dose levels increased for the extracts. (Baker-IVI)
W84-04544

DETERMINATION OF VOLATILE HALOCARBONS IN WATER BY PURGE-CLOSED LOOP GAS CHROMATOGRAPHY,
Harbor Branch Foundation, Inc., Fort Pierce, FL.
T. Wang, and R. Lenahan.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 4, p 429-438, April, 1984. 5 Fig, 5 Tab, 8 Ref.

Descriptors: *Pollutant identification, *Gas chromatography, *Halogenated hydrocarbons, Volatile compounds, Water analysis, Organic compounds.

Concentrations of volatile halocarbons in water at the parts per billion level have been determined using gas chromatography in conjunction with Hall electrolytic conductivity, electron capture detection or flame ionization. When a water sample that contains organic compounds is placed in a closed-loop system, organics will equilibrate between the water and the headspace during the purging period. Distribution of compounds between the two phases depends on temperature, vapor pressure for each compound, sample matrix influences on compound activity coefficients, ratio of headspace to liquid volume in the entire closed system, purge time and gas purge rate. The time and method used to equilibrate samples will affect gas chromatographic responses. Since the purge and trap technique is currently popular, a brief comparison was conducted between this method and the purge-closed loop method. The results were not significantly different and both methods delivered a relative standard deviation of less than 10%. (Baker-IVI)
W84-04545

ORGANOCHLORINE RESIDUE LEVELS IN MISSISSIPPI RIVER WATER SNAKES IN SOUTHERN LOUISIANA,
Louisiana State Univ., Baton Rouge. Dept. of Zoology and Physiology.
T. D. Sabourin, W. B. Stickle, T. C. Michot, C. E. Villars, and D. W. Garton.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 4, p 460-468, April, 1984. 3 Tab, 17 Ref.

Descriptors: *Organochlorine compounds, *Snakes, *Mississippi River, *Louisiana, Baton Rouge, Belle Helene, Organic compounds, DDT, HBC, Lindane, Aldrin, Endrin, Heptachlor epoxide, Polychlorinated biphenyls, Pesticide residues, Biological magnification.

The usefulness of water snakes for pollution monitoring was investigated by assessing the organochlorine load in tissues of snakes inhabiting three sites along the Mississippi River near Baton Rouge, Louisiana. The levels of PCB's, DDT and its metabolites and other organochlorine residues (dieldrin, heptachlor epoxide, hexachlorobenzene, heptachlor, hexachlorobenzene, endrin, and lindane) in the individual tissues are summarized. Highest concentrations detected were in the fat bodies, intermediate levels were located in liver samples and lowest concentrations in muscle tissue. No correlation existed between organochlorine load and sex, length or weight. The concentration of HCB was significantly greater in snakes of both species taken from Belle Helene, by a ten fold increase over snakes taken from the other areas. The Belle Helene sampling area lies within an area which received considerable attention in 1973 for HCB contamination of cattle. Use of the snakes appears to be a promising method of monitoring water pollution. (Baker-IVI)
W84-04547

MEASURING POLLUTION USING MAGNETISM,
Liverpool Univ. (England). Dept. of Botany.
R. Maxted.
Water and Waste Treatment, Vol. 27, No. 3, p 47, March, 1984.

Descriptors: *Path of pollutants, *Pollutant identification, *Magnetism, Erosion, Sediment transport, Wastewater disposal, Magnetic tracing, Magnetic studies, Monitoring, Iron oxides.

A whole new range of instruments and sensors has been developed which uses the presence of iron oxides to establish rates, chronologies, and distribution of pollution and sediment. Both natural and artificial processes produce iron oxides which are magnetic, chemically stable, and specific to their source and mode of formation. High temperatures are used to convert iron compounds in natural materials to magnetic oxides. The heat treatment can be applied successfully to all particle sizes from coarse gravel to fine silt or even clay. Magnetic tracing has been used to determine the effects of floods and the movement of many industrial and municipal wastes by seeding the effluents. The use of mineral magnetism can confer a number of advantages in terms of time and spatial scale in many monitoring programs. (Baker-IVI)
W84-04558

BOD RESULTS THAT ARE BELIEVABLE,
Environmental Engineering Consultants, Inc., Stillwater, OK.
E. L. Stover, and D. E. McCartney.
Water Engineering and Management, Vol. 131, No. 4, p 37-40, 62, 66, April, 1984. 4 Fig, 5 Ref.

Descriptors: *Wastewater analysis, *Biochemical oxygen demand, Monitoring, Nitrification, Dissolved oxygen, Wastewater treatment, Bioassay.

The BOD5 test is not a measure of the quantity of organic material in wastewater, but instead is a bioassay procedure for assessment of the amount of oxygen required for the respiratory functions of the microorganisms in the BOD bottle. Biological inhibition of the heterotrophic (carbonaceous) microorganisms can cause low BOD values while, on the other hand, nitrification during the five-day test period can cause high values to be observed. Dissolved oxygen depletion due to the dilution water itself can influence the variability observed during BOD determinations. The following general rules should make BOD test results less variable and increase the confidence placed in them by the testers. Use acclimated seed material with complex wastewaters. Inhibit nitrification when appropriate. Determine seed demand and dilution water depletions with multiple dilutions. Apply appropriate correction factors. Dilution water correction can be calculated according to the amount of dilution water used if desired. Select seed concentration to yield between 0.2 and 1.0 mg/l oxygen demand. During data interpretation, place greater emphasis on sample volumes with higher total depletion. The influences of water and seed corrections are minimized during the calculation of these BOD values. Best sample volumes for BOD calculations are those with net depletions between 25 and 75% of the initial DO values. Place more

emphasis on sample volumes with greater than 2.0 mg/l net depletion. Plot BOD versus sample volume to determine inhibition. Use sample volumes below the threshold inhibition level for BOD calculations. (Baker-IVI)
W84-04559

SPECTROPHOTOMETRIC DETERMINATION OF TOTAL TRIHALOMETHANES IN FINISHED WATERS,
Wisconsin Univ.-Milwaukee. Dept. of Civil Engineering.
J. Y. C. Huang, and G. C. Smith.
American Water Works Association Journal, Vol. 76, No. 4, p 168-171, April, 1984. 4 Tab, 22 Ref.

Descriptors: *Spectrophotometry, *Trihalomethanes, *Treated water, Sodium hydroxide, Pyridine, Gas chromatography, Comparison studies, Chlorination, Performance evaluation.

Research into a spectrophotometric method for measuring total trihalomethanes in drinking water is described. The procedure is based on the classic Fujiwara reaction, which is characterized by the red color that develops when a halogen compound is heated with sodium hydroxide and pyridine. This method can provide a semiquantitative screening of THMs at water treatment plants that are not equipped with a GC. This technique would be especially useful for water utilities that have limited laboratory budgets but are trying to compare trends in THM concentration or rank the THM content of different samples. Although less sensitive and less specific than gas chromatography, this method is relatively simple and inexpensive and could be used in water treatment plant laboratories to screen for total trihalomethanes in finished waters. (Murphy-IVI)
W84-04586

COMPUTER STORAGE AND EVALUATION OF WATER QUALITY BIOLOGICAL DATA,
Nottingham Univ. (England). Dept. of Zoology.
R. T. Joy.
Environmental Pollution (Series B), Vol. 6, No. 1, p 1-14, 1983. 2 Fig, 4 Tab, 16 Ref.

Descriptors: *Computers, *Computer programs, *Water quality, *Biological samples, Trent biotic index, Community diversity index, Performance evaluation.

Computer programs were employed to merge the data from a series of samples of macro-invertebrate fauna and to calculate cumulative values of Trent Biotic and Community Diversity Indices. While the values of both indices are related to the degree of pollution present in the water, they are also dependent upon sample size. It is suggested that water quality may be adequately assessed by either index value calculated for a standard sample containing 1000 organisms. When cumulative data are pooled from a range of locations differing widely in the degree of pollution it is apparent that the two indices are highly correlated with each other. It is concluded that the Trent Biotic Index is a semiquantitative rather than a qualitative parameter. (Author's abstract)
W84-04615

USE OF WATER QUALITY INDEX FOR RIVER CLASSIFICATION AND ZONING OF GANGA RIVER,
Roorkee Univ. (India). Dept. of Civil Engineering.
D. S. Bhargava.
Environmental Pollution (Series B), Vol. 6, No. 1, p 51-67, 1983. 3 Fig, 7 Tab, 7 Ref.

Descriptors: *Water quality index, *River classification, *River zoning, *Ganga River, Water quality standards, Model studies, Water pollution control, Computers.

The practice of river classification on the basis of standards is difficult to apply because, in many cases, not all water quality variable values satisfy the corresponding limits set for a single class of use. In such situations, it would be simpler and more rational to classify a river for a given use on the basis of an index derived to include the integrated effect and relative importance of each relevant variable in the given use. Criteria and methodology for evolving such quality indices and limits of significant variables for the different grades of the various beneficial uses of a water are proposed. The simplified model for the Water Quality Index (WQI) has been used to evaluate the WQI values of the River Ganga for its various uses. The use of WQI is exploited for the classification and zoning of Ganga. The river standards for pollution control and water quality management can also be prescribed in terms of the WQI. (Author's abstract)
W84-04617

ARSENIC, GOLD AND MERCURY CONCENTRATION LEVELS IN FRESHWATER FISH BY NEUTRON ACTIVATION ANALYSIS,
Benin Univ., Benin City (Nigeria). Dept. of Chemistry.
C. L. Ndiokwere.
Environmental Pollution (Series B), Vol. 6, No. 4, p 263-269, 1983. 2 Tab, 10 Ref.

Descriptors: *Arsenic, *Gold, *Mercury, *Fish, *Neutron activation analysis, Bioaccumulation, Niger River, Niger Delta, Nigeria.

Elemental concentrations of arsenic, gold and mercury have been determined in flesh tissues of freshwater fish species from some Nigerian rivers. The technique of neutron activation followed by radiochemical separation of the isotopes of interest has been applied. The concentrations of 0.04-0.87 microg/g and 0.4-1.33 microg/g obtained for gold and mercury, respectively, in the samples are much higher than the values reported in the literature for freshwater fish. The arsenic concentration range of 0.07-0.42 microg/g is within the reported range. The high concentration levels of these heavy metals can be attributed to local contamination of the rivers. (Author's abstract)
W84-04621

DETERMINATION OF LOWER HALOGENATED HYDOCARBONS BY THE WATER-XYLENE EXTRACTION METHOD,
Yokohama National Univ. (Japan). Inst. of Environmental Science and Technology.
M. Inoko, M. Tsuchiya, and T. Matsuno.
Environmental Pollution (Series B), Vol. 7, No. 1, p 129-140, 1984. 5 Fig, 2 Tab, 7 Ref.

Descriptors: *Water-xylene extraction method, *Halogenated hydrocarbons, Performance evaluation, Drinking water, Water analysis, Hydrocarbons, Trace levels.

A modified liquid extraction method for determining trace amounts of lower halogenated hydrocarbons in drinking water has been studied. A 45 ml sample solution containing not less than 5 microg/liter of CHCl3, CHCl:CCl2, CHBrCl2, CHClBr2, CHBr3 and CCl2:CCl2 and 0.4 microg/liter of CCl4 was extracted with 5 ml of xylene. The equilibrium concentrations of lower halogenated hydrocarbons in the xylene phase were determined by a gas chromatograph equipped with an electron capture detector and using a column which consists of tricresylphosphate (90 cm), squalane (170 cm) and silicone DC 200 (40 cm). By means of this method, microg/liter levels of lower halogenated hydrocarbons in drinking water were determined successfully. (Author's abstract)
W84-04627

CONSTRAINTS AND CATEGORIES OF VADOSE ZONE MONITORING DEVICES,
Kaman Tempo, Santa Barbara, CA.
For primary bibliographic entry see Field 7B.
W84-04640

SOME AQUATIC INSECTS AS WATER QUALITY INDICATORS IN THE RIVER KHAN,
Madhav Science Coll., Ujjain (India). Dept. of Zoology.
D. S. Rao, and A. B. Saxena.
International Journal of Environmental Studies, Vol. 20, No. 3/4, p 281-284, March, 1983. 1 Fig, 2 Tab, 9 Ref.

Descriptors: *Bioindicators, *Water analysis, *Aquatic insects, *River Khan, *India, Population dynamics, Rivers, Insects, Water quality.

The River Khan is is a shallow, turbulent river originating near the city of Indore. About eight million gallons of sewage and industrial wastes are discharged into the river daily. The insect community structure was used to evaluate water pollution in the River Khan. The different types of insect characterize the various saprobic zones in the river. Bearing in mind the physico-chemical conditions of water at the place of occurrence of the insects, various saprobic designations have been assigned to the insect groups. These studies reveal that the insect communities in the river give an approximation of the water quality conditions in the river. (Baker-IVI)
W84-04655

FLUORIDE CONCENTRATION IN THE WATER OF THE RIVER CAUVERY, KARNATAKA, INDIA,
Mysore Univ. (India). Dept. of Botany.
R. K. Somashekar, and S. N. Ramaswamy.
International Journal of Environmental Studies, Vol. 21, No. 3-4, p 325-327, 1983. 1 Fig, 1 Tab, 7 Ref.

Descriptors: *Fluoride, *India, *Karnataka, *River Cauvery, Water pollution effects, Public health, Aquatic life, Fish, Industrial wastes, Chemical industry, Pulp and paper industry, Bioaccumulation.

Cauvery is one of the important rivers of Karnataka with a total length of 1500 km. The water of this river is used for domestic as well as for industrial purposes all along its course. The survey for fluoride level was made at five sampling points stretching over a distance of about 25 km. Sampling station 3 receives large amounts of effluents from fertilizer and paper factories. The effluents of a fertilizer factory have an average fluoride concentration of 300 mg/l. The water of this river is unsuitable for domestic use at a few stations along its course because of the high fluoride concentrations. Fluoride rich water has also posed a threat to the bird sanctuary located at one of the sampling points. The higher concentrations of fluorides in this study are also known to accumulate in the aquatic biota and subsequently reach man through food chains, thus leading to health hazards in the area. (Baker-IVI)
W84-04661

METHOD FOR BIOLOGICAL QUALITY ASSESSMENT OF WATERCOURSES IN BELGIUM,
Ghent Rijksuniversiteit (Belgium). Lab. for Biological Research in Aquatic Pollution.
N. De Pauw, and G. Vanhooren.
Hydrobiologia, Vol. 100, p 153-168, April, 1983. 2 Fig, 7 Tab, 55 Ref.

Descriptors: *Water quality, *Measurement instruments, *Belgium, Bioindicators, Biological properties, Water quality standards, Sampling, Biotic index.

A description is given of the method generally used in Belgium to assess the quality of running water. It involves the determination of a biotic index with scores between 0 and 10, based on samples of the aquatic macro-invertebrate community collected in situ, using a handnet. The Belgian method combines the advantages of two existing biological assessment methods. Its major advantages are its simplicity, speed, reliability, low cost, and practical utility. Its limitations and difficulties as well as the needs for further research are briefly discussed. The method, called the Belgian Biotic Index Method, is applicable to various types of watercourses and has recently been proposed to the Belgian Institute for Normalization for approval as a standard method. For several years, the Belgian government has based its strategy towards

surface water sanitation on water quality maps, visualizing the biotic indices obtained by the biological assessment method. As such, Belgium is advancing the recommendations for biological water quality monitoring being worked out by the Environmental and Consumer Protection Service of the Commission of the European Communities. (Author's abstract)
W84-04689

ROTIFERS AS INDICATORS OF WATER QUALITY,
Prague Dept. of Water Technology (Czechoslovakia).
V. Sladecek.
Hydrobiologia, Vol. 100, p 169-201, April, 1983. 3 fig, 2 Tab, 193 Ref.

Descriptors: *Rotifers, *Bioindicators, *Water quality, Toxicity, Biological properties, Biological samples, Trophic level, Ecology, Saprobiology, Species diversity.

Six hundred and twenty species and lower taxonomical units of Rotatoria found in Czechoslovakia and surrounding countries are listed alphabetically and classified according to water quality. The numerical characteristics include the saprobic valence in 10 balls, the indicative weight of species (Ii) and the individual saprobic index (Si). Rotifers are considered to be good indicators. The situation is illustrated by four graphs and the relation to BOD5 values is stressed. All rotifers are aerobic organisms and occur only within limnosaprobity. They can also serve as indicators of trophic conditions. To characterize the situation in standing the slowly flowing waters a Brachionus:Trichocerca quotient is proposed. Rotifers can also be used as test organisms in toxicity experiments. (Murphy-IVI)
W84-04690

ACCUMULATION OF HEAVY METALS BY AQUATIC MOSSES: 1: FONTINALIS ANTIPYRETICA HEDW.,
Durham Univ. (England). Dept. of Botany.
P. J. Say, and B. A. Whitton.
Hydrobiologia, Vol. 100, p 245-260, April, 1983. 3 Fig, 11 Tab, 35 Ref. Department of the Environment contract DGR/480/571.

Descriptors: *Bioaccumulation, *Heavy metals, *Aquatic mosses, *Fontinalis, Measuring instruments, Aquatic plants, Pollution load, Monitoring, Zinc, Manganese, Lead.

An account is given of methods developed to monitor heavy metals in rivers by measuring the concentration of these metals in Fontinalis antipyretica Hedw. Key features of the standard method recommended include the harvesting of materials from microhabitats with fast current speeds wherever possible, thorough washing in field and laboratory, use of terminal 2-cm lengths of shoot, drying at 105 degrees C and digestion in 2 M HNO3. In order to establish the extent to which this species is useful and to provide baseline data with which others can compare their own observations, samples of moss, water and sediments were harvested for analysis from 52 different sites in northern England and Belgium. Significant positive correlations were obtained between Cu and Zn in 2-cm tips and in both (total) water and sediment, but in the case of Cd and Pb only between 2-cm tips and sediment. Multiple stepwise regression was used to quantify the apparent influence of environmental variables. For instance, with PB in the moss as the dependent variable, significant influences were found for Zn in the moss (+ve) aqueous Mn (+ve) and filtrable reactive phosphate (-ve). Variables which were significant were incorporated in each case into equations to predict the concentration of metal that would be expected if allowance was made for the concentration of all these variables at each site. In the case of Pb, sq r = 0.075 for metal in moss versus aqueous metal, whereas sq r = 0.879 for metal in moss versus the predicted value for metal in moss. This suggests that the lack of correlation between Pb in moss and Pb in water was probably due largely to the influence of other variables. For Cd, the difference was less: sq r = 0.013 and sq r = 0.47, respectively. A principal components analysis was also carried out, with measurements of water and moss as the variables ordinated. An example is given of the use of the moss to monitor intermittent Zn pollution in R. Wear. (Author's abstract)
W84-04692

ACCUMULATION OF HEAVY METALS BY AQUATIC MOSSES. 2: RHYNCHOSTEGIUM RIPARIOIDES,
Durham Univ. (England). Dept. of Botany.
J. D. Wehr, and B. A. Whitton.
Hydrobiologia, Vol. 100, p 261-284, April, 1983. 8 Fig, 20 Tab, 38 Ref. Department of the Environment DGR/480/571.

Descriptors: *Bioaccumulation, *Heavy metals, *Aquatic mosses, *Rhynchostegium, Measuring instruments, Monitoring, Aquatic plants, Pollution load, Copper, Zinc, Cadmium, Barium, Lead.

A study was made of general ecology and metal accumulation in the widespread aquatic moss Rhynchostegium riparioides, (Hedw.) C. Jens. with a view to developing the use of this species as a monitor of heavy metal pollution. In order to establish a data bank for statistical analysis, samples of water and moss were taken within a 6-week period from 105 sites (10-m reaches) in Northern England from streams and rivers of diverse physical and chemical types. Analyses were made of 14 metals (Na, Mg, K, Ca, Cr, Mn, Fe, Co, Ni, Cu, Zn, Cd, Ba, Pb) in both 2-cm tips and whole plants. The same 14 metals were also measured in both total and filtrable water, together with 12 other variables. Samples of tips were easier to prepare for analysis, but had significantly ($p < 0.001$) lower concentrations of all metals except Na and K. Significant correlations ($p < 0.001$) between metal in moss and aqueous metal were found for ten metals (Na, K, Mg, Ca, Mn, Cu, Zn, Cd, Ba, Pb). Correlations between metals in moss and in water were in general similar for tips and whole plants, but much higher for tips with Na, Zn and Cd; the relationship was quite similar whether total or filtrable water was considered, with the exception of Ba where the correlation was much higher with the latter. A multiple regression was used to suggest which variables in water and/or moss may influence accumulation of Co, Ni, Cu, Zn, Cd, Ba and Pb in the moss. For instance, the variables which had a very highly significant effect on Pb in tips were Pb, filtrable reactive phosphate and Zn in the water. A discussion is included of how the data may be used for monitoring purposes. (Author's abstract)
W84-04693

ACCUMULATION OF HEAVY METALS BY AQUATIC MOSSES. 3: SEASONAL CHANGES,
Durham Univ. (England). Dept. of Botany.
J. D. Wehr, and B. A. Whitton.
Hydrobiologia, Vol. 100, p 285-291, April, 1983. 5 Fig, 3 Tab, 9 Ref. Department of the Environment DRG/480/571.

Descriptors: *Bioaccumulation, *Heavy metals, *Aquatic mosses, *Seasonal variation, Measuring instruments, Monitoring, Pollution load, Amblystegium, Fontinalis, Rhynchostegium.

The changes taking place at seven stream and river sites over a 14-month period were followed for the following: 1) % cover of Rhynchostegium riparioides; 2) relative abundance of Rhynchostegium as part of the whole plant community and, where present, also Amblystegium riparium and Fontinalis antipyretica; 3) 18 water chemistry variables; 4) concentrations of nine metals in 2-cm tips of Rhynchostegium at all sites and of Amblystegium and Fontinalis at one site each. A decrease in the amounts of these mosses occurred in winter at most sites, the effect being most pronounced with Amblystegium. Nevetheless, the majority of plants which remained had healthy shoots suitable for sampling for metal analysis at all times of year. There were marked temporal changes in the concentrations of metals in the 2-cm tips at each site, but few of these appeared to be related to seasonal events. The most plausible was for Pb in Rhynchostegium at a main river site, where increased accumulation in winter was probably an indirect effect of other chemical differences in the water during a period of high flows. Provided healthy shoots were available, there was no indication of seasonal differences in metal accumulation resulting from features of the mosses themselves. (Author's abstract)
W84-04694

GAS CHROMATOGRAPHIC DETERMINATION OF TOTAL AMINO ACIDS AND PROTEIN IN SEDIMENTS USING THE NINHYDRIN-CO2 REACTION,
Freshwater Biological Association, Windermere (England).
B. M. Simon, and J. G. Jones.
Hydrobiologia, Vol. 101, No. 3, p 189-194, May, 1983. 3 Fig, 5 Tab, 18 Ref.

Descriptors: *Gas chromatography, *Amino acids, *Protein, *Sediments, *Ninhydrin, *Carbon dioxide, Measuring instruments.

Several methods have been used to determine total amino acids in water and soils. Some methods can be of limited use in anoxic samples, particularly sediments. A sensitive modification of the ninhydrin-CO2 method involving the gas chromatographic determination of the total protein and amino acid content of sediment is described. The method gives a linear response over the amino acid concentration range 0.00001 M to 4 x .01 M. It can be used for whole sediment, hydrolysates and interstitial water. The performance of the method is compared with the fluorescamine method for primary amines. (Murphy-IVI)
W84-04711

CHRYSOPHYCEAN CYSTS: INDICATORS OF EUTROPHICATION IN THE RECENT SEDIMENTS OF FRAINS LAKE, MICHIGAN, U.S.A.,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
H. J. Carney, and C. D. Sandgren.
Hydrobiologia, Vol. 101, No. 3, p 195-202, May, 1983. 11 Fig, 23 Ref.

Descriptors: *Chrysophycea, *Eutrophication, *Paleolimnology, *Frains Lake, *Michigan, Stratigraphy, Sedimentation, Bioindicators, Bioaccumulation.

The recent sediments of Frains Lake, Michigan contain a rich and well preserved association of chrysophycean cysts. Forty one forms are revealed by scanning electron microscopy (SEM) and light microscopy (LM). Taxonomic descriptions and SEM micrographs are provided for the dominant forms. The three dominant taxa throughout the sediments, Cysta minima, C. modica and C. subbavaricum, do not show significant shifts in proportional abundance associated with European settlement and the onset of cultural eutrophication. However, certain subdominant taxa do show clear trends. Density counts indicate a dramatic decline in cyst concentration (by volume and by dry mass) and a sharp increase in absolute accumulation (net annual influx) following settlement. The Frains Lake profile of chrysophycean cysts is compared to sequences of other North American and European temperature lakes. The utility of chrysophycean cysts as paleoenvironmental indicators is considered on the basis of these results. (Author's abstract)
W84-04712

CHEMICAL EXTRACTION OF HEAVY METALS IN POLLUTED RIVER SEDIMENTS IN CENTRAL EUROPE,
Technische Univ., Hamburg (Germany, F.R.).
W. Calmano, and U. Forstner.
The Science of the Total Environment, Vol. 28, p 77-90, June, 1983. 2 Fig, 3 Tab, 46 Ref.

Descriptors: *Heavy metals, *Sediments, Pollutant identification, Zinc, Cadmium, Lead, Copper,

Rhine River, Rotterdam Harbor, Weser Estuary, Neckar River, Extraction, Estuarine environment.

A five-step sequential extraction technique was used to determine the chemical association of heavy metals (Zn, Cd, Pb, Cu) with major sedimentary phases (exchangeable cations, easily and moderately-reducible compounds, organic/sulfidic phases, residual components) in samples from polluted rivers in Central Europe (Middle Rhine River, Lower Rhine/Rotterdam Harbor, Weser Estuary, Neckar River). Data gained suggest that the surplus of metal contaminants introduced into the aquatic system from anthropogenic sources usually exists in relatively unstable chemical forms. The more important accumulative phases for trace metals are found in the easily-reducible fractions. Extraction with acidified hydroxylamine solution seems to yield the metal fractions which may predominantly participate in short-term geochemical and biochemical processes. Rates of mobilization were significantly higher for zinc and cadmium than for copper and lead. (Author's abstract)
W84-04741

BROWN SEAWEED, FUCUS VESICULOSUS, AND THE GASTROPOD, LITTORINA LITTORALIS, AS INDICATORS OF TRACE-METAL AVAILABILITY IN ESTUARIES,
Marine Biological Association of the United Kingdom, Plymouth (England).
G. W. Bryan.
The Science of the Total Environment, Vol. 28, p 91-104, June, 1983. 3 Fig, 4 Tab, 28 Ref.

Descriptors: *Algae, *Gastropods, *Trace metals, *Bioindicators, *Estuarine environment, Silver, Cadmium, Lead, Zinc, Salinity, England, Wales, Fucus, Littorina, Bioavailability.

Fucus vesiculosus appears to be a good indicator of the bioavailable forms of Ag, Cd, Cu, Pb, Zn and probably other metals in seawater. Experimental concentration factors for Ag, Cu and Pb were similar at sea water concentrations differing by a factor of 10, but for Cd and Zn factors were lower at higher levels. With decreasing salinity, concentration factors for Cd tended to increase, but this was less evident for Zn, high concentrations of which substantially reduced Cd accumulation. Concentrations of 10 metals in Littorina littoralis from a range of sites in England and Wales were compared with those of F. vesiculosus on which it grazes. The gastropod was a good indicator of Cd contamination but was less useful than F. vesiculosus for most other metals. (Author's abstract)
W84-04742

QUANTITATION OF METAL COMPLEXES BY REVERSE-PULSE AMPEROMETRY AND MOLECULAR-EXCLUSION CHROMATOGRAPHY,
North Dakota Univ., Grand Forks. Dept. of Chemistry.
For primary bibliographic entry see Field 2K.
W84-04770

5B. Sources Of Pollution

HEAT TRANSFER; ENVIRONMENTAL ASPECTS,
Notre Dame Univ., IN. Dept. of Aerospace and Mechanical Engineering.
A. M. Kanury.
Mechanical Engineering, p 28-39, June, 1983. 12 Fig, 12 Ref.

Descriptors: *Thermal pollution, *Environmental effects, Powerplants, Nuclear waste, Waste heat, Thermal powerplants, Thermal stratification, Stratification, Thermal stress, Heated plumes, Heat transfer, Water cooling.

Atmospheric and aquatic dispersion of heat, geothermal heat transfer, and management of process byproducts are explored. The demand for electric power has resulted in recent years in the construction of large numbers of big power plants throughout the world. For every unit of energy converted to eletricity, approximately two units are discharged into the environment. Among the major research problems currently faced in the design of evaporative cooling towers are: the effects of crosswinds upon draft, heat exchange, and drift entrainment of hot water droplets in the exhaust gas flow; the consequences of cold weather ice formation; fill heat and mass transfer coupling; and the internal aerodynamics of cooling tower flows that determine the pressure losses and heat transfer rates. Discussion is offered concerning aquatic and atmospheric stratification, heat disposal to water bodies, heat transfer in porous media, heat transfer in soils, and high level nuclear waste storage. (Baker-IVI)
W84-04199

THE BEHAVIOR OF BARIUM IN A LANDFILL AND THE UNDERLYING SOIL,
Rijksinstituut voor Drinkwatervoorziening, Leidschendam (Netherlands). Chemical Biological Div.
P. Lagas, J. P. G. Loch, C. M. Bom, and L. J. A. Gerringa.
Water, Air and Soil Pollution, Vol. 22, No. 2, p 121-129, 1984. 3 Fig, 2 Tab, 6 Ref.

Descriptors: *Barium, *Landfills, Industrial wastes, Waste dumps, Leaching, Soil properties, Water pollution sources, Netherlands.

The behavior of Ba in a landfill and the soil was studied because at several locations in The Netherlands heat treatment waste from metal processing companies, containing Ba, was dumped in codisposal with domestic waste. Experiments were set up to study the behavior of Ba under controlled conditions; columns were filled with a layer of sand soil, on top of which a layer of ground domestic waste was placed. A layer of Ba-containing salt was imbedded in the waste. Special attention was given to the influence of the location of the Ba-containing salt in the waste layer and the influence of the groundwater level on the behavior of Ba. The results indicate that 18 to 39% of the Ba that was added to the columns leached, probably in the form of organic Ba-complexes. Part of the Ba was adsorbed or precipitated in the sand or the waste layer, while part of the Ba remained at the original place of application in the form of BaCO3. (Author's abstract)
W84-04209

DBCP RESIDUE STUDIES IN SOIL AND WELL WATER FROM TWO SOUTH CAROLINA PEACH ORCHARDS,
Clemson Univ., SC. Dept. of Plant Pathology and Physiology.
G. E. Carter, Jr., J. T. Ligon, and M. B. Riley.
Water, Air, and Soil Pollution, Vol. 22, p 201-208, 1984. 5 Tab, 8 Ref.

Descriptors: *1,2-Dibromo-3-chloropropane, *DBCP, *Peach orchards, *South Carolina, Water pollution, Water pollution sources, Pesticides, Contamination, Soil contamination, Nematodes.

The soil fumigant 1,2-dibromo-3-chloropropane (DBCP) was used to control ring and root-knot nematodes, both of which are major contributors to 'peach tree short life'. Soil samples collected from a peach orchard near a well containing 1 microg/kg (DBCP) (contaminated) and from a peach orchard with a well containing 0.1 microg/kg DBCP (uncontaminated) contained less than 0.1 microg/kg and 0.5 microg/kg DBCP residue, respectively. Soil profiles did not explain the presence of DBCP in the contaminated well. However, a possible spill of DBCP approximately 30 m from the contaminated well may have contaminated the well water. Soil samples taken at the site of the possible spill contained high concentrations of DBCP in the upper meter and at 6.1 m where the water table was encountered. The water contamination resulted from this spill of DBCP and not from normal agricultural use. (Murphy-IVI)
W84-04211

NITRATE CONTAMINATION OF SUBSURFACE WATERS IN AN URBANIZING AREA,
Case Western Reserve Univ., Cleveland, OH. Dept. of Geological Sciences.
G. Matisoff, J. M. Inglis, and W. R. Kelly.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-159748, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Center Report OSURF No. 713266, Ohio State Univ., Columbus, September, 1983. 29 p, 6 Fig, 1 Tab, 24 Ref. Project No. OWRT A-066-OHIO (1).

Descriptors: *Groundwater, *Nitrates, *Chlorides, *Computer models, *Solute transport, Unconfined aquifers, Groundwater pollution, Groundwater level, Groundwater recharge, Groundwater movement, Geohydrology, Model studies, *Ohio, Lake County, Water pollution sources, Path of pollutants, Groundwater flow model, Solute transport model, Road salt runoff, Hydrogeology.

The ground water system in northern Perry Township in Lake County, Ohio is a shallow, unconfined aquifer consisting of glacial lake beach deposits and less permeable lacustrine plain deposits. Groundwater flow is generally from south to north, but strong, local variations are caused by northward flowing streams. The areal distributions of chloride and nitrate suggest that recharge is derived from local infiltration. Groundwater flow and solute transport models were used to simulate flow and pollutant transport in the study area under hydrologic steady-state rates of 0-4 feet per day which indicate that in excess of 27 years are required to obtain chemical steady-state. The simulations also demonstrate that nitrate loading must occur in more than one cultivated field and that a commercial nursery is not the sole source of contamination. Road salt run-off easily infiltrates the aquifer and can be readily described by the model. The results underscore the susceptibility of shallow aquifers to even modest surficial chemical contamination. In such cases it may be necessary to implement some types of land use control or to restrict the development of groundwater.
W84-04227

MODELING STREAMLINES AND MASS TRANSPORT IN CIRCULATING FLOW,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W84-04229

IRON SPECIATION IN ACID MINE EFFLUENTS: CHEMICAL AND MICROBIAL CONTROLS,
Ohio State Univ., Columbus. Dept. of Agronomy.
J. M. Bigham, O. H. Tuovinen, K. S. Brady, and T. J. Logan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-159664, Price codes: A03 in paper copy, A01 in microfiche. Ohio Water Resources Center, Columbus Completion Report No. 714437, (1984). 29 p, 8 Fig, 3 Tab, 33 Ref. Project No. OWRT A-068-OHIO (1).

Descriptors: *Acid mine water, *Iron compounds, *Iron bacteria, *Oxidation, Chemical precipitation, Hydrolysis, *Ohio, Black Fork Creek watershed, Mine drainage, Bioreactors.

The Black Fork Creek watershed, located in Perry and Morgan Counties, Ohio, was selected as a representative field site for evaluating the solution chemistry of iron in streams receiving acid coal mine drainage. Water samples from a point source of acid discharge and a 2 km downstream section of the receiving stream were examined in detail. The total sulfate content, total iron content, Eh and pH of the acid effluent were 4500 microg/ml, 1250 microg/ml, + 584 mV and 2.9, respectively, at the time of sampling. Ferrous iron accounted for 95% of the total iron load. Both total and ferrous iron showed rapid, 10-fold decreases in the receiving stream even though pH of the stream water remained less than 3.5. The fraction of polymeric iron (greater than 0.1 microm esd) increased from 6% in the acid effluent to almost 50% of the total iron load at points farthest downstream. UV-spectroscopic analyses of the stream water indicated

that Fe(OH)(2+) and Fe2(OH)2(4+) may be important intermediate species in polymer formation. A laboratory bio-reactor was tested for potential use in the treatment of acid mine drainage. Cells of Thiobacillus ferroxidans were immobilized in an alginate matrix and used in a packed-bed column reactor for the continuous oxidation of Fe(II) in synthetic ferrous sulfate solutions. Oxidation efficiencies of over 90% were attained within 14 to 35 days for aerated columns operating at room temperature with influent Fe(II) concentrations of 55 mM. The presence of mineral salts in the influent solution resulted in a shorter lag period before a steady state of iron oxidation was achieved. Chemical (abiotic) oxidation of Fe(II) was insignificant in the aerated columns, which were operated up to three months without a loss of activity.
W84-04230

A WATER HANDBOOK FOR METAL MINING OPERATIONS,
Colorado School of Mines, Golden. Dept. of Chemistry and Geochemistry.
R. Wildeman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-159755, Price codes: A05 in paper copy, A01 in microfiche. Colorado Water Resources Research Institute, Fort Collins, Completion Report No. 113, November, 1981. 84 p, 11 Fig, 4 Tab, 50 Ref, 2 Append. Project No. OWRT A-034-COLO (5), Contract/Grant No. 14-34-0001-6006.

Descriptors: Water quality control, *Mine drainage, Water analysis, *Metal mines, *Colorado, Front Range, Mining, *Chemical analysis, *Pollutant identification, Effluents, Weathering, *Water quality standards.

This is a handbook that operators of metal mines can use to understand how the various substances originate in mine water and what can be done to eliminate or control their occurrence. The introductory chapters review the chemical weathering reactions of rock forming and ore minerals, and the environmental standards that apply to drinking water and mining and milling effluents. Then there is a discussion of how various physical factors such as ore petrology, groundwater hydrology, and type of ore occurrence can affect the quality of mine drainages. This chapter is based on extensive investigations of mine drainages within the Front Range of Colorado. A plan for analysis of mine waters that emphasizes understanding the chemical nature of the water is established. Finally, suggestions for water maintenance are made based on the chemistry of the water and the analysis schedules. An appendix is a manual of common methods of analysis which emphasizes how to conduct successful tests in the environment of a mining operation.
W84-04233

DENITRIFICATION AS A MECHANISM FOR NITROGEN REMOVAL IN AEROBIC SYSTEMS: FEASIBILITY ANALYSIS,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
A. J. McDonnell, S. E. Strand, and J. J. Warwick.
Available from the National Technical Information Service, Springfield, Va 22161 as PB84-159698, Price codes: A08 in paper copy, A01 in microfiche. PIRLWR, Completion Report (LW8402), The Pennsylvania State University, University Park, February, 1984. 153 p, 7 Fig, 4 Tab, 305 Ref, 2 Append. Project No. OWRT A-053-PA (1), Contract/Grant No. 14-34-0001-2140.

Descriptors: *Denitrification, *Nitrogen, *Nitrate, *Nitrogen removal, Sediments, Soils, Literature reviews, *Aerobic conditions, Dissolved oxygens, Nitrogen mass balance model.

Nitrogen losses from apparently aerobic aquatic systems have often been attributed to denitrification in anoxic microenvironments. An extensive literature review was made to evaluate the extent and magnitude of denitrification as it has been observed in aquatic ecosystems. Measurement of nitrogen loss in aquatic sediments are reviewed and factors that influence denitrification identified. A reconnaissance survey was made on the fate of nitrogen in a shallow, productive stream. Analysis, using a dissolved oxygen and nitrogen mass balance model in tandem, indicated significant nighttime in-stream denitrification derived nitrogen loss in the presence of dissolved oxygen concentrations of 2 to 3 mg/l. Results are considered too preliminary at the present time to draw substantive conclusions.
W84-04239

HYDROGEOLOGIC INVESTIGATION OF THE MAXEY FLATS RADIOACTIVE WASTE BURIAL SITE, FLEMING COUNTY, KENTUCKY,
Geological Survey, Louisville, KY. Water Resources Div.
H. H. Zehner.
USGS Open-File Report 83-133, 1983. 148 p, 38 Fig, 30 Tab, 40 Ref.

Descriptors: *Radioactive waste disposal, *Groundwater pollution, *Groundwater movement, Hydrology, Geologic fractures, *Radiochemical analysis, Aquifer characteristics, Base flow, Transmissivity, Radioactive well logging, *Kentucky, Borden Formation, Sunbury Shale, Bedford Shale, Ohio Shale.

Burial trenches at the Maxey Flats radioactive waste burial site cover an area of about 20 acres, and are located on a plateau, about 300 to 400 feet above surrounding valleys. All waste is buried in the Nancy Member of the Borden Formation, and most is in the weathered shale (regolith) part of this member. Recharge to the rocks is probably by infiltration of rainfall through regolith at the top of the hill. At least two water tables are present: near the base of the regolith, at a depth of about 25 feet and; in the Ohio Shale, at a depth of about 300 feet. About 95 percent of ground-water discharge to streams is from colluvium on hillsides and valley alluvium. The remaining 5 percent is discharge from bedrock, of which about 0.5 percent is from rocks underlying the burial area. Waste radionuclides in the subsurface, other than tritium, were observed only in the regolith of the Nancy Member. Only tritium was observed with certainty in deeper rocks and in the adjacent valley alluvium. Other waste radionuclides were in streamwater and stream sediment, and may have been transported with overland runoff from the surface of the burial site. (USGS)
W84-04244

WATER-QUALITY ASSESSMENT OF WHITE RIVER BETWEEN LAKE SEQUOYAH AND BEAVER RESERVOIR, WASHINGTON COUNTY, ARKANSAS,
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 5C.
W84-04259

GROUNDWATER CONTAMINANT TRANSPORT MODELING,
Princeton Univ., NJ. Dept. of Civil Engineering.
G. F. Pinder.
Environmental Science and Technology, Vol. 18, NO. 4, p 108A-114A, April, 1984. 6 Fig, 8 Ref.

Descriptors: *Groundwater flow, *Solute transport, Model studies, Computers, Mathematical models, Equations, Groundwater pollution.

The use of groundwater transport modeling has seen enormous growth during the past 10 years. Current modeling efforts are very often motivated by a desire to simulate subsurface contaminant movement. Advanced computer technology has helped the groundwater model evolve from a scientific curiosity to an important and widely used engineering tool. Specific information is offered concerning groundwater flow, solute transport, numerical simulation, transport modeling, modeling strategy, field applications, and remedial strategies. (Baker-IVI)
W84-04289

DYNAMICS OF A FERTILIZER CONTAMINANT PLUME IN GROUNDWATER,
Illinois State Water Survey Div., Champaign.
M. J. Barcelona, and T. G. Naymik.
Environmental Science and Technology, Vol. 18, No. 4, p 257-261, April, 1984. 3 Fig, 2 Tab, 19 Ref.

Descriptors: *Groundwater pollution, *Fertilizers, Inorganic nitrogen, Mathematical model, Numerical solute transport model, Illinois.

A 2-year investigation has been conducted on the effects of a massive inorganic nitrogen fertilizer contamination of a sand and gravel aquifer in western Illinois. Groundwater monitoring in the early period of the project during near steady-state conditions disclosed that dissolved ammonium and nitrate levels exceeded 2000 and 13000 mg/L, respectively. A numerical solute transport model was applied to the system which predicted that approximately 420 days would be necessary after source removal to permit recovery of the aquifer water to near background levels within the study site. Subsequent monitoring results generally supported the model prediction and demonstrated its usefulness for predicting transport and transformations of inorganic forms of nitrogen. The chemistry and microbiology of the impact groundwater showed significant changes attendant to pollutant removal which indicate that microbially mediated processes occurred in the aquifer. (Author's abstract)
W84-04290

OCTACHLOROSTYRENE IN LAKE ONTARIO: SOURCES AND FATES,
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
R. Kaminsky, and R. A. Hites.
Environmental Science and Technology, Vol. 18, No. 4, p 275-279, April, 1984. 4 Fig, 1 Tab, 28 Ref. EPA grant 808961.

Descriptors: *Octachlorostyrene, *Lake Ontario, Water pollution sources, Fate of pollutants, Biological magnification, Chlorinated styrenes.

The presence of octachlorostyrene (OCS) in samples of fish from Lake Ontario has been particularly puzzling since this compound has never been a commercial product. The concentration of octachlorostyrene (OCS) was measured in dated segments of 11 sediment cores taken from Lake Ontario in order to establish the depositional history of this compound in the lake. OCS (as well as other chlorinated syrenes and chlorinated polycyclic aromatic hydrocarbons) originates primarily from the waste product of electrolytic chlorine production. This waste, called 'taffy', resulted from the chlorination of the tar or pitch used to bind graphite electrodes; its improper disposal led to the introduction of chlorinated aromatic compounds into the environment. OCS is present in all major sediment depositional areas of Lake Ontario and may be subject to biomagnification. Although OCS exhibited no toxicity or mutagenicity in a bacterial bioassay, the long-term environmental impact of chlorinated styrenes is still unknown. (Murphy-IVI)
W84-04291

BUTYLTIN COMPOUNDS AND INORGANIC TIN IN SEDIMENTS IN ONTARIO,
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
For primary bibliographic entry see Field 5A.
W84-04292

RADIUM AND BARIUM IN THE AMAZON RIVER SYSTEM,
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences.
For primary bibliographic entry see Field 2K.
W84-04296

SALINITY AND WEATHERING RATE OF ROCKS IN A SEMI-ARID REGION,

Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
L. M. Moreira-Nordemann.
Journal of Hydrology, Vol. 71, No. 1-2, p 131-147, March 15, 1984. 4 Fig, 5 Tab, 39 Ref.

Descriptors: *Salinity, *Weathering rate, *Rocks, *Semiarid lands, Geochemistry, Total dissoved solids, Cations, Indicators, Uranium, Saline water systems, Salgado River, Brazil.

Rain- and river-water samples were collected for one year in the Salgado River basin, a semi-arid region in Bahia State, Brazil. Total dissolved solids (TDS) concentrations, and Na, Ca, K, Mg and U contents were measured in these samples and also in rock and soil samples of the basin. A geochemical balance and the chemical weathering rate of rocks were determined from these results. The water of Salgado River showed high concentrations of TDS (1.42 g/l) and cations; thus it was impossible to determine the chemical weathering rate of rocks by using these major cations as indicator elements. A rate of 36 t sq km/yr was obtained by using uranium as a natural tracer. Salgado River water belongs to the most abundant group of surface waters found in northeastern Brazil, that is, salty waters with high NaCl concentrations. (Author's abstract)
W84-04304

STREAM SALINITY IN THE INDIAN ARID ZONE,
Central Arid Zone Research Inst., Jodhpur (India).
J. S. Choudhari, and K. D. Sharma.
Journal of Hydrology, Vol. 71, No. 1-2, p 149-163, March 15, 1984. 5 Fig, 5 Tab, 22 Ref.

Descriptors: *Salinity, *Streams, *India, *Arid zone, Rainfall-runoff relationships, Runoff volume, Chemical properties, Total dissolved solids, Magnesium, Potassium, Water quality.

Streams in the Indian desert are ephemeral in nature and carry water only in direct response to torrential rainfall. Streamwater quality was determined in the Indian desert for a period of three years, 1979-1981. Total dissolved salts (TDS) varied from 161 to 12,495 mg/l in various streams, depending upon the geology, landscape and volume of runoff. Highest concentrations of TDS were recorded at the onset of runoff in the initial flow event, followed by a rapid decrease in concentrations during the rising and recession flow stages. Sodium concentrations decreased with increasing discharge whereas calcium concentrations increased with discharge. Magnesium and potassium concentrations remained relatively uniform throughout the flow. TDS and individual ion concentrations displayed an annual fluctuation. Maximum concentration values were recorded following a flood year whereas minimum concentrations occur during the flood year. (Murphy-IVI)
W84-04305

NITRATE POLLUTION OF CHALK GROUNDWATER IN EAST YORKSHIRE - A DECADE ON,
Institute of Hydrology, Wallingford (England).
A. R. Lawrence, S. S. D. Foster, and P. W. Izzard.
Journal of the Institution of Water Engineers and Scientsts, Vol. 37, No. 5, p 410-420, October, 1983. 5 Fig, 1 Tab, 7 Ref.

Descriptors: *Groundwater contamination, *Nitrate, *Chalk aquifer, *East Yorkshire, *England, Water quality, Water pollution sources.

The records of nitrate concentration in two public groundwater supply sources in the Chalk aquifer of East Yorkshire during the 1970's are presented and interpreted with the aid of a program of unsaturated zone investigation. This program involved drilling 11 cored boreholes to allow the determination of porewater profiles for nitrate, ammonium, sulfate, chloride, calcium, sodium, and tritium, together with the measurement of matrix porosity and hydraulic conductivity. The current fluctuations in concentration of nitrate at a dip-slope source, such as Etton, are primarily a function of the proportion of arable land use in the groundwater catchment, the average unsaturated zone thickness and the borehole construction. The regime of groundwater quality fluctuations at an escarpment source, such as Market Weighton, is different, reflecting the greater importance of rapid unsaturated zone by-pass flow and saturated zone mixing. The rate and mode of downward migration of higher oncentrations through the unsaturated zone will be of importance in the precise prediction of future groundwater quality. The groundwater nitrate problem in East Yorkshire does not appear as severe as that in some of the drier areas of the Chalk outcrop, primarily, as a consequence of higher infiltration rates resulting in greater dilution of soil nitrate excess to crop requirements during the winter months, and secondarily of the somewhat higher proportion of non-arable land. (Baker-IVI)
W84-04309

PRELIMINARY ESTIMATES OF LOADS CARRIED BY RIVERS TO ESTUARIES AND COASTAL WATERS AROUND GREAT BRITAIN DERIVED FROM THE HARMONIZED MONITORING SCHEME,
J. C. Rodda, and G. N. Jones.
Journal of the Institution of Water Engineers and Scientists, Vol. 37, No. 6, p 529-538, December, 1983. 2 Fig, 3 Tab, 27 Ref.

Descriptors: *Estuaries, *Sediment transport, *Rivers, *Great Britain, Coastal waters, Land use, Water pollution sources, Industrial wastes, Sulfates, Nitrates, Zinc, Copper, Chloride, Orthophosphate, Cadmium, Lead.

Rivers carry a wide variety of materials in solution, in suspension, and by saltation. Some of this material originates from natural sources, the remainder is from sources dependent on man and his activities. Preliminary estimates are given of the loads of eight chemical determinands carried by the rivers draining Great Britain: chloride, nitrates, sulfate, orthophosphate, zinc, cadmium, lead, and copper. The loads of British rivers show considerable diversity, reflecting the relative abundance and heterogeneity of sources in the basins they drain. This diversity results from the wide variety of rock and soil types, together with the assortment of contrasting industrial, urban, and agricultural land use patterns which together create the distinctive scenery of the islands. Climate also causes natural variations of the flows of rivers to extend over four orders of magnitude. The distribution of sulfate loads is largely related to sources dependent on industry such as on mine drainage and on washout and deposition of atmospheric sulfur compounds emitted by thermal power stations. Uncertainties involved in the assessment of the loads of these determinands are noted. (Baker-IVI)
W84-04316

CHEMICAL AND TOXICITY ANALYSIS OF LEACHATES FROM COAL CONVERSION SOLID WASTES,
Pittsburgh Univ., PA. Dept. of Civil Engineering.
R. D. Neufeld, and S. Wallach.
Journal of the Water Pollution Control Federation, Vol. 56, No. 3, p 266-273, March, 1984. 9 Fig, 5 Tab, 10 Ref. DOE contract DE-AC-18-79FC10061.

Descriptors: *Coal gasification, *Leaching, *Solid wastes, *Industrial wastes, *Fly ash, *Sludges, Sulfur, Metals, Toxicity, Path of pollutants, Daphnia.

Eight coal conversion solid wastes were used for this project: gasifier fly ash, bottom ash, sludges from the treatment of gasifier waste waters, and liquification bottoms materials. It proved impossible to stereotype coal conversion solid wastes as the waste depended on both the process and type of coal used. The fly ash materials were considerably smaller in particle size than the bottom materials. The ASTM-A procedure leached the least amount of metals, the EPA-EP an intermediate amount, and the PITT procedure the most materials. A summary of each of the three leaching procedures is offered. EPA-EP leachates from the wastewater lime sludge and alum sludge would not be considered hazardous under RCRA even through the total organic carbon concentrations exceeded 2500 mg/L and LC-50 values were very low. With the exception of the sludge leachates, none of the ASTM-A leachates exhibited acute Daphnia magna toxicity. All the EPA-EP leachates and the ASTM-A sludge leachates showed strong acute Daphnia magna toxicity. A log-log relationship was found between CL-50 data and the weighted sum of metals data for the EPA-EP leachates generated from the fly ash and all bottom solid wastes. A log-log relationship was found between LC-50 data and the phenol concentrations for the leachates generated from the lime and alum wastewater sludges. (Baker-IVI)
W84-04326

LEAD CYCLING IN ESTUARIES, ILLUSTRATED BY THE GIRONDE ESTUARY, FRANCE,
Ecole Normale Superieure, Paris (France). Lab. de Geologie.
F. Elbaz-Poulichet, P. Holliger, W. W. Huang, and J. M. Martin.
Nature, Vol. 308, No. 5958, p 409-414, March-April, 1984. 5 Fig, 2 Tab, 24 Ref.

Descriptors: *Lead cycling, *Estuaries, *Gironde estuary, *France, Physical properties, Recycling, Sediments, Turbidity, Lead, Water pollution sources, Fate of pollutants.

The cycling of lead in estuaries involves a complex exchange between dissolved and particulate phases. In macrotidal estuaries such as the Gironde (France), dissolved lead is absorbed onto particles due to an increase in turbidity and in the specific surface area of particles in the tidal estuary. In the lower estuary a mobilization of exchangeable and carbonate lead occurs simultaneously with a coagulation of organic dissolved lead associated with iron-manganese hydrous oxides. The lead-depleted particles are subsequently recycled to the tidal estuary by landward currents, where they become mixed with fresh river-borne particles. Lead isotopic ratios and particulate lead speciation studies indicate that in this estuary the mixing of polluted particles with old deposits probably has a minor role in the decrease in particulate lead. (Author's abstract)
W84-04338

NATURAL RADIOACTIVITY OF FRESH WATERS IN POLAND,
Central Lab. for Radiological Protection, Warsaw (Poland).
D. Grzybowska, T. Wardaszko, and J. Nidecka.
Polskie Archiwum Hydrobiologii, Vol. 30, No. 4, p 309-318, 1983. 1 Fig, 6 Tab, 19 Ref.

Descriptors: *Radioactivity, *Fresh waters, *Poland, Deep waters, Well waters, Tap waters, Radium, Uranium, Thorium, Radon.

The natural radioactivity of waters is interpreted as the content of radioelements of all three radioactive series, irrespective of whether they originate from processes spontaneously proceeding in nature or from human activities. Concentration of natural radioelements: Ra-226, U, Th and Rn-222, in various kinds of fresh waters in Poland were determined. They were found to be near the lower limit of range of concentrations observed in other countries. The investigated waters differed in the Ra-226 content depending on their origin; when listed in order of decreasing Ra-226 concentration, these waters assumed the following sequence: deep waters > surface waters > well waters > tap waters. (Murphy-IVI)
W84-04339

DECLINE OF MERCURY IN YOUNG FISHES FROM WESTERN LAKE ERIE BETWEEN 1970-71 AND 1974,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
W. D. N. Busch.
Progressive Fish Culturist, Vol. 45, No. 4, p 202-206, October, 1983. 3 Fig, 2 Tab, 17 Ref.

Descriptors: *Mercury, *Fish, *Lake Erie, Methylmercury, Bioindicators, Shiner, Bass, Perch, Drum, Fate of pollutants.

Concentrations of total mercury were determined for samples of age 0-II whole fish of six species collected from western Lake Erie in 1970-71 and five species collected in 1974. Within years, average total mercury concentrations increased with age and size in all species. The concentrations were significantly lower (37 to 86%) in 1974 than in 1970-71. Methylmercury concentrations and the proportion of methylmercury to total mercury increased with age and size of fish in samples of four species collected in 1970-71. (Author's abstract)
W84-04343

ORGANIC CONTAMINANT BEHAVIOR DURING RAPID INFILTRATION OF SECONDARY WASTEWATER AT THE PHOENIX 23RD AVENUE PROJECT,
Stanford Univ., CA. Dept. of Civil Engineering.
E. J. Bouwer, P. L. McCarty, H. Bouwer, and R. C. Rice.
Water Research, Vol. 18, No. 4, p 463-472, 1984. 5 Fig, 8 Tab, 26 Ref.

Descriptors: *Fate of pollutants, *Rapid infiltration, *Groundwater recharge, *Organic compounds, *Phoenix, *Arizona, Water reuse, Wastewater renovation, Volatilization, Biodegradation, Sorption, Halogenated organic compounds, Aliphatic compounds, Aromatic compounds, Groundwater pollution.

Movement of trace organic pollutants during rapid infiltration of secondary wastewater for groundwater recharge was studied at the 23rd Avenue Rapid Infiltration Project in Phoenix, Arizona. Samples of the wastewater applied to the spreading basins and of renovated water taken from monitoring wells were characterized for priority pollutants and other specific organic compounds using gas chromatography/mass spectrometry. The concentrations of organic constituents were affected by volatilization, biodegradation and sorption process. Nonhalogenated aliphatics and aromatic hydrocarbons exhibited concentration decreases of 59-99 degrees, during soil percolation. Halogenated organic compounds were generally removed to a lesser extent. Concentrations of trichloroethylene, tetrachloroethylene, and pentachloroanisole appeared to be significantly higher in the renovated water than in the basin water, reasons for this behavior remain unclear. Many organic contaminants were detected in the groundwater indicating such systems should be designed to localize contamination of the aquifer. Chlorination of the wastewater had no significant effect on contamination and types of trace organic compounds. (Author's abstract)
W84-04353

SOME EXACT SOLUTIONS FOR SOLUTE TRANSPORT THROUGH SOILS CONTAINING LARGE CYLINDRICAL MACROPORES,
Agricultural Research Service, Riverside, CA. Salinity Lab.
For primary bibliographic entry see Field 2G.
W84-04358

AN ADVECTION-DIFFUSION CONCEPT FOR SOLUTE TRANSPORT IN HETEROGENEOUS UNCONSOLIDATED GEOLOGICAL DEPOSITS,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2F.
W84-04361

A LAGRANGIAN POROUS MEDIA MASS TRANSPORT MODEL,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
N. R. Thomson, J. F. Sykes, and W. C. Lennox.
Water Resources Research, Vol. 20, No. 3, p 391-399, March, 1984. 11 Fig, 2 Tab, 38 Ref.

Descriptors: *Path of pollutants, *Porous media, *Groundwater pollution, *Mass transport, Mathematical models, Groundwater movement, Advection, Dispersion.

The mathematical simulation of advective dispersive contaminant transport in groundwater involving large Peclet numbers is subject to numerical difficulties. For most numerical models the computational cost and computer core requirements escalate as the Peclet number increases. A two-dimensional Galerkin finite element model for flow and Lagrangian mass transport in porous media has been developed to alleviate numerical and computational difficulties. The solution methodology involves a linear triangular mesh which tracks along streamlines calculated from a flow equation having the stream function as the dependent variable. A comparsion of this model to Eulerian or fixed coordinate type models showed this model to be accurate and stable at a reduced computational effort. For an actual field contamination problem which contains large vertical concentration gradients, the simulated results compared with observed data. (Author's abstract)
W84-04363

POSSIBLE EVIDENCE FOR ENRICHMENT OF TRACE ELEMENTS IN THE HYDROUS MANGANESE OXIDE PHASES OF SUSPENDED MATTER FROM AN URBANIZED EMBAYMENT,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
R. A. Feely, G. J. Massoth, A. J. Paulson, and J. F. Gendron.
Estuarine, Coastal and Shelf Science, Vol. 17, No. 6, p 693-708, December, 1983. 10 Fig, 4 Tab, 48 Ref.

Descriptors: *Path of pollutants, *Bays, *Estuarine environment, *Trace elements, *Managanese oxide, *Duwamish River, *Elliot Bay, *Washington, Suspended solids, Particulates, Chromium, Nickel, Copper, Zinc, Lead, Heavy metals, Sediments, Heavy metals.

Near the mouths of many rivers, significant quantities of Mn are released from rapidly accumulating recent sediments and precipitate onto suspended matter in the overlying water. In the laboratory, freshly precipitated Mn oxide surfaces tend to readily sorb trace elements. Total and weak-acid-soluble trace elements in suspended matter from the Duwamish River and Elliott Bay, an urbanized estuary-embayment system in northwest Washington State, were determined from samples collected in February and September 1980. Mn scavenging in the water column is coincident with enrichments of Cr, Ni, Cu, Zn, and Pb in the suspended matter, suggesting a possible enrichment of these trace elements in a hydrous Mn oxide phase. The newly formed hydrous Mn oxides, which form coatings on the surfaces of fine particles in suspension, are to a significant degree exported from Elliot Bay. This process may be an important means for transporting trace elements from polluted estuaries and embayments to less polluted coastal and open-ocean environments. (Moore-IV)
W84-04369

EFFECTS OF AN OIL SPILL IN OUTDOOR MODEL TIDAL FLAT ECOSYSTEMS,
Hoffdgroep Maatschappelijke Technologie TNO, Den Helder (Netherlands). Vestiging Den Helder - Biologisch Veldwerk.
J. Kuiper, P. De Wilde, and W. Wolff.
Marine Pollution Bulletin, Vol. 15, No. 3, p 102-106, March, 1984. 6 Fig, 14 Ref.

Descriptors: *Oil spills, *Tidal waters, *Model studies, Ecosystems, North Sea, Tidal flats, Wadden Sea, Estuarine environment.

Oil Pollution Experiments (OPEX) are discussed which are designed to collect information on the possible effects of a spill threatening the tidal flats of the Wadden Sea, and to provide a basis for optimum treatment of such a spill. A one-year feasibility study was carried out with MOdel TIdal Flat ecosystems (MOTIFs), designed to represent tidal flat systems typical of the Wadden Sea and other temperate estuarine areas. During the first 6 months the 4 MOTIFs studied developed very similarly. After this period an oil spill was simulated by exposing two of the four MOTIFs to a floating oil mousse for one week. During this week part of the oil was buried in the sediment by bioturbation. This sediment-bound fraction caused a prolonged exposure of the MOTIFs to oil compounds. Short- and long-term effects resulted in large differences between oil-treated and control MOTIFs. These differences persisted to the end of the experiment, 7 months after the removal of most of the oil. (Baker-IVI)
W84-04395

DISSOLVED ORGANIC MATTER IN COASTAL WATERS AT JEDDAH, SAUDI ARABIA,
King Abdulaziz Univ., Jeddah (Saudi Arabia). Faculty of Marine Science.
A. K. A. Behairy, and M. M. El-Sayed.
Marine Pollution Bulletin, Vol. 15, No. 3, p 113-116, March, 1984. 1 Fig, 3 Tab, 11 Ref.

Descriptors: *Coastal waters, *Dissolved organic matter, Saudi Arabia, Jeddah, Red Sea, Water pollution effects, Wastewater pollution.

Water samples collected during April 1982-April 1983 from Red Sea coastal waters at Jeddah, Saudi Arabia, were investigated for dissolved organic carbon, dissolved organic nitrogen, dissolved lipid, dissolved organic phosphorus, dissolved monosaccharides, total dissolved sugars and dissolved polysaccharides. The variations in the observed dissolved matter distribution pattern are caused by its release by phytoplankton in the various stages of its growth, release from detrital materials and its pouring from exogenous sources like domestic wastes or other types of pollutants, and their utilization by heterotrophic organisms. Extremely high DOC values at two stations can be attributed to the direct effect of untreated wastes at those two locations. Since the consumption of oxygen is intimately linked to the oxidation of organic matter, in the presence of high concentrations of organic matter the consumption rate of oxygen will exceed that of its supply, leading to a reducing condition which favors the accumulation of excess organic matter. (Baker-IVI)
W84-04396

PURGEABLE ORGANICS IN TENNESSEE GROUNDWATERS: A PROBLEM ASSESSMENT,
Tennessee Univ., Knoxville. Coll. of Engineering.
R. Robinson, D. Reed, and R. L. Jones.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84169432, Price codes: A06 in paper copy, A01 in microfiche.
Water Resources Research Center Report No. 99, December 1983. 6 Fig, 11 Tab, 58 Ref, 1 Append. Project No. OWRT A-065-Tenn(1), Contract/Grant No. 14-34-0001-0145.

Descriptors: *Tennessee, Groundwater, *Groundwater pollution, Water quality, *Path of pollutants, Trichloroethylene, Tetrachloroethylene, Methyl chloroform, Organic compounds, *Chlorinated hydrocarbons, Water pollution sources, Pollutant identification, Gas chromatography.

A study was conducted in Tennessee to determine if there is a problem with groundwater pollution by volatile organic compounds, specifically trichloroethylene (TCE), tetrachloroethylene (PCE), and methyl chloroform (MC). Groundwater samples were taken in Knox and Rutherford Counties and Davidson County wells near the Rutherford County border because of the favorable conditions. Samples were also taken in Blount, Cocke, Hamblen, Hawkins, Jefferson, Sevier, and Sullivan Counties at public water supplies using groundwater as a raw water source. There appear to be reasons for concern with groundwater contamination in Tennessee by volatile organic compounds. Industrialized urban and nearby surrounding areas are the places where groundwater contamination by TCE, PCE, and/or MC has and can be found. Of the 15 groundwater sources sampled and analyzed for TCE, PCE, and MC in industrial and

urban areas, 6 were found to contain 1 or more of the compounds at levels of 0.1 micrograms/l or more (40 percent of the sources tested). None of these compounds were found in groundwater from rural area sources above 0.1 micrograms/l.
W84-04412

BACTERIAL POLLUTION FROM AGRICULTURAL SOURCES: A REVIEW,
Oregon State Univ., Corvallis. Dept. of Agricultural Engineering.
S. R. Crane, J. A. Moore, M. E. Grismer, and J. R. Miner.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 3, p 858-866, 872, May-June, 1983. 5 Tab, 82 Ref.

Descriptors: *Bacteria, *Agriculture, *Water pollution sources, *Livestock, Reviews, Animal wastes, Agricultural runoff, Vegetation, Surface waters, Bioindicators, Infiltration, Leaching.

The extent of bacterial contamination of surface and ground waters associated with animal production units and waste application areas seems largely to depend on the production and waste management practices used by individual livestock operations. Management practices must be developed and proven both technologically and economically feasible which will reduce to a small percentage the indicator and pathogenic bacteria lost from these sites. Even with implementation of the best management practices, the indicator bacterial densities in runoff will probably range from 1000 to 100,000 organisms/100 mL as has been shown previously to be the base or background level from agriculturally oriented land use areas. Specifics are offered concerning the determination of the quantity of bacteria transported from animal waste application sites, recommended practices to reduce health risks, management practices to minimize bacterial losses, application time and use of storage facilities, and site selection criteria for waste application sites and livestock operations. (Baker-IVI)
W84-04446

EROSION OF SOIL AND POULTRY MANURE - A LABORATORY STUDY,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
P. W. Westerman, T. L. Donnelly, and M. R. Overcash.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 4, p 1070-1078 and 1084, July-August, 1983. 1 Fig, 12 Tab, 45 Ref.

Descriptors: *Manure, *Soil erosion, *Path of pollutants, Water pollution sources, Farm wastes, Land application, Rainfall intensity, Sediment transport, Loading rate, Waste disposal.

Land application of livestock and poultry manures on bare soil can result in high availability of nutrients for transport in surface runoff which may result in pollution of streams, rivers and lakes. Farmers often wait several days after manure application before they incorporate the manure. The transport of soil and manure by simulated rainfall on 1 m x 0.64 m laboratory test plots was investigated to determine the effects of rainfall intensity, soil type, manure type, loading rate and drying time. A factorial experimental design was used with each factor at two levels. Rainfall intensity and soil type were significant factors for solids transport, and manure loading rate was a significant factor for nutrient transport. Loading rain strongly influenced volatile solids, manure soilds and nutrient transport. Manure type and drying time were also significant factors for transport of certain nutrients. Increased drying time reduced manure and soil transport. Several factors and their interactions had significant effects on erosion and transport of soil, manure and nutrients. Prediction models of erosion and nutrient transport from areas receiving manure should consider several factors, including manure type, manure loading rate, and time between application and rainfall. (Moore-IVI)
W84-04450

RUNOFF LOSSES OF NUTRIENTS AND SOIL FROM GROUND FALL-FERTILIZED AFTER SOYBEAN HARVEST,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. L. Baker, and J. M. Laflen.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 4, p 1122-1127, July, August, 1983. 6 Tab, 13 Fig.

Descriptors: *Fertilizers, *Nutrients, *Water pollution sources, *Agricultural runoff, *Soil erosion, Soybeans, Tillage, Point-injection, Water quality control.

Plot measurements of soil and nutrient runoff concentrations and losses were made for two simulated rains in the fall after soybean harvest and fertilization (N, P, and K at 31, 35, and 80 kg/ha, respectively). The five treatments were: fertilizer surface-applied, no incorporation; fertilizer point-injected into the soil; fertilizer incorporated by chisel plowing; fertilizer incorporated by disking; and no fertilizer applied, no tillage. Chisel plowing reduced surface residue coverage from 82% (before tilage and the first rain) to 48%; disking reduced coverage to 31%. About half the residue buried by tillage was uncovered by the first rain. Sediment concentrations in runoff from the tillage plots were about three times higher than from the no-tillage plots. For rain 1 (111 mm), loosening the soil by tillage reduced runoff amounts, particularly from the chisel-plow treatment; for rain 2(72 mm), runoff from the disked treatment was about three times that from the other treatments. Total soil loss from the disk treatments was 2.3 T/ha, which was at least three times higher than any other treatment. Concentrations of NH4-N, PO4-P, and K in runoff water and on sediment from treatments where fertilizer was incorporated by either point-injection or tillage were at the same levels as from the unfertilized treatment. Chemical concentrations from the surface-application-without-incorporation treatment were significantly higher than from all other treatments, particularly for the first rain (e.g., NH4-N greater than 3 mg/L, PO4-P greater than 0.9 mg/L, and K greater than 18 mg/L). Total NH4-N, PO4-P, and K losses were also the greatest for the surface-applications-without-incorporation treatment, but were only 0.8, 0.4, and 5.9 kg/ha, respectively. On the basis of these results, fall fertilization would not be recommended because of water quality concerns. If fertilizer is applied, no tillage should be performed because of the potential for increased soil losses; but if tillage is performed, chisel plowing would be preferred to disking. When point-injection of liquid fertilizers becomes feasible on a large scale, its advantage of nutrient incorporation without residue incorporation will warrant its recommendation. (Author's abstract)
W84-04457

COMPARISON OF RUNOFF QUALITY FROM CATTLE FEEDING ON WINTER PASTURES,
Idaho Univ., Moscow.
J. E. Dixon, G. R. Stephenson, A. J. Lingg, D. V. Naylor, and D. D. Hinman.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 4, p 1146-1149, July-August, 1983. 5 Tab, 7 Ref.

Descriptors: *Pastures, *Cattle, *Hay, *Water pollution sources, Idaho, Irrigation-return flow, Alfalfa, Grasses, Water pollution control, Filter crops.

Most cow-calf ranchers in the rocky Mountain Region confine their cattle during the winter and graze them from late spring to early fall. During the grazing season, most of the confinement areas are irrigated and used to produce alfalfa or mixed species hay. The loss of ten chemical, two bacteriological, and four other constituents from cow-calf wintering areas in Owyhee County, Idaho was quantified. Three hay crops were examined for their potential to filter the pollutants from the holding area runoff. Three hay crops (ground cover) treatments with two replications were established using a mixture of alfalfa with one of three grasses: brome, fescue, and orchardgrass. Cattle were placed on plots each winter and removed each spring for three years. The plots were irrigated twice each year. Irrigation and runoff flows were monitored and water samples taken for analysis. An analysis of variance showed no significant difference between the ground cover treatment means for any constituent, although there was a trend toward better pollutant retention with the alfalfa-fescue mixture. The amount of constituent loss through irrigation return flow from land wintering cattle seems to be small. (Moore-IVI)
W84-04460

ERODIBILITY OF SELECTED RECLAIMED SURFACE MINED SOILS,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
J. K. Mitchell, W. C. Moldenhauer, and D. D. Gustavson.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 5, p 1413-1421, September-October, 1983. 4 Tab, 13 Ref.

Descriptors: *Soil erosion, *Land reclamation, *Strip mines, Water pollution sources, Surface runoff, Storm runoff, Soil conservation, Sediments.

The contribution of erosion from reclaimed surface mined land to sediment pollution of surface waters was evaluated. Rainulator test sites were established on three sites, representing different soil types. Unmined sites refer to those that were not disturbed by mining operations although they had been under cultivation; whereas reclaimed refers to land that has been mined and the topsoil replaced. The plots received simulated rainfall of 64 mm/h, consisting of an initial rainulator runoff 60 min followed about one hour later by two 30 min runs on the wet soil. Soil losses per EI unit and calculated erodibilties from the initial storms (dry runs) were generally lower than those resulting from subsequent storms (wet and very wet runs). Mean soil erodibilities for the respective runs were generally greater on the unmined sites than those calculated for the reclaimed sites. An average annual soil erodibility factor was calculated by using the formula developed for the soil erodibility nomograph to place the observed values more nearly on an annual basis. These values appeared well suited for use in the Universal Soil Loss Equation on reclaimed surface mined lands for computing average annual soil losses or designing conservation practices. The estimates of the average annual soil erodibility factor for the reclaimed sites were 74% of the corresponding unmined estimates on the average. (Baker-IVI)
W84-04467

COMPARISON OF SIMULATED AND MEASURED NITRATE LOSSES IN TILE EFFLUENT,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
R. S. Kanwar, H. P. Johnson, and J. L. Baker.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 5, p 1451-1457, September-October, 1983. 8 Fig, 3 Tab, 28 Ref.

Descriptors: *Nitrates, *Tile drainage, *Simulation, Fertilizers, Water pollution sources, Computer models, Hydrologic models, Effluents.

The current agricultural practice of making a single application of nitrogen fertilizer to meet the demands of the crop for the entire year may result in nitrogen leaving the system through leaching, wash-off and volitilization or staying in the soil for possible later use. Nitrogen leached out of the root zone may reduce the quality of groundwater or surface water. A hydrologic and nitrate-transport simulation model was developed and used to simulate the major water and nitrogen-transport processes occurring in a typical agricultural watershed during the crop growth period. Data from a tile drainage experiment were used to evaluate the simulation model. The model predictions agreed reasonably well with the measured values of tile drainage water and nitrate losses in the tile effluent. The difference between measured and predicted values indicates that the hydrology of the area is not completely understood in the present form of model or that some of the soil moisture properties estimated do not reflect the actual field conditions.

Measured as well as predicted data indicate that an equivalent of nearly half of the applied fertilizer nitrogen is being discharged with tile drainage water. (Moore-IVI)
W84-04472

INFLUENCE OF LIVESTOCK ON NONPOINT SOURCE NUTRIENT LEVELS OF STREAMS,
Tennessee Valley Authority, Knoxville.
A. M. Duda, and D. S. Finan.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 6, p 1710-1716, November-December, 1983. 6 Fig, 5 Tab, 19 Ref.

Descriptors: *Livestock, *Nonpoint pollution sources, *Nutrients, *North Carolina, Drainage, Forest watersheds, Nitrogen, Phosphorus, Animal wastes, Storm runoff.

Ten agricultural watersheds with widely varying populations of livestock were instrumented to collect samples of lowflow and storm-event nutrient concentrations. Conducted in the Piedmont and Coastal Plain of North Carolina, the investigation demonstrated that much higher concentrations of nutrients occur in watersheds with extensive artificial drainage and larger nonpoint source populations of livestock than in similar agricultural watersheds with low populations of livestock. In addition, comparisons were made with nutrient levels previously recorded in forested watersheds in North Carolina. For total phosphorus, agricultural watersheds without high populations of livestock had mean concentrations 5 to 10 fold greater than mostly forested watersheds, while those with high populations of livestock approached 50 fold increases. For total inorganic nitrogen, the increases over forested watersheds approached 100 fold for agricultural watersheds with high populations of livestock. Observations are made concerning the production of stormflow from variable source areas in the watershed and the significance of animal waste and agricultural drainage improvements in causing elevated levels of nutrients in coastal waters. (Author's abstract)
W84-04479

NITRATE CONTENT OF GROUND WATERS IN AGRICULTURAL AREAS OF THE OKA RIVER BASIN,
V. N. Bashkin, and V. N. Kudeyarov.
Soviet Soil Science, Vol. 15, No. 1, p 41-47, 1983. 5 Fig, 11 Ref. Translated from Agrokhimiya, No. 2, p 14-19, 1983.

Descriptors: *Water pollution sources, *Groundwater pollution, *Nitrates, *Oka River Basin, *USSR, Statistical analysis, Gorodnyanka River, Skniga River, Itska River, Sokhna River, Oka River, Farming, Fertilizers, Animal wastes.

A significant but non-linear correlation between the nitrate content of ground waters and the application of nitrogen containing mineral fertilizers, total mineral and organic fertilizer nitrogen and cattle populations has been established in four agricultural areas. The areas were small rivers basins, Gorodnyanka, Skniga, Itska, and Sokhnam, each a tributary of the Oka with a total area of about 866 sq km. The areas differed only in their proportion of agricultural lands, the amounts of mineral and organic fertilizers applied, and cattle populations. The average nitrate nitrogen content varied by area and time of observation, ranging from 44 to 10 mg/liter, and tended to increase during the winter compared with the previous summer. (Baker-IVI)
W84-04517

MOVEMENT OF ALDICARB IN DIFFERENT SOIL TYPES,
California Univ., Davis. Dept. of Environmental Toxicology.
T. M. Awad, W. W. Kilgore, and W. Winterlin.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 4, p 377-382. April, 1984. 1 Fig, 2 Tab, 11 Ref.

Descriptors: *Path of pollutants, *Pesticides, Aldicarb, Groundwater pollution, Pesticide residues, Soil properties, Soil types, Clay, Loam, Sand, Leaching.

The movement of aldicarb was studied in different soil types under lab conditions and the effects of large volumes of water on this movement was also investigated. Thirty-five grams of 8 different but well defined soils were packed in individual glass columns and tapped lightly. Twenty-five mg of aldicarb active ingredient in formulated form were added to the top of the column and mixed thoroughly with the top inch of soil. Three aliquots of 50 mL each of distilled water were then added to the top of the soil columns. Soil types included sand, loam, clay, sandy-loam, clay-loam, silt-loam, muck, and peat. Clay soil retained the highest amount of aldicarb residues followed by loam soil. The apparent retention of aldicarb residues by loam and clay soils may be a function of water flow as well as some type of physical binding to the soil particles. The lowest amounts of aldicarb residues were found in sandy, sandy-loam and peat soils. (Baker-IVI)
W84-04542

2,3,6-TRICHLOROPHENYLACETIC ACID (FENAC) DEGRADATION IN AQUEOUS AND SOIL SYSTEMS,
State Univ. of New York Coll. of Environmental Science and Forestry, Syracuse. School of Landscape Architecture.
A. Rosenberg.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 4, p 383-390, April, 1984. 3 Fig, 15 Ref.

Descriptors: *Fate of pollutants, *Herbicides, *Biodegradation, *Trichlorophenylacetic acid, *Fenac, Sewage, Wastewater, Lake water, Soil water, Nutrients, Microorganisms.

The environmental fate of 2,3,6-trichlorophenylacetic acid was examined by studying its biodegradation and product formation in sewage, lake water, soil and soil suspensions. Metabolism of fenac was first determined by using lake water and the primary effluent of municipal sewage. Degradation was followed by GLC and HPLC of extracted aliquots of the mixtures in the flasks. In the nutrient-supplemented lake water, degradation was evident within one month and reached nearly 25% of the initial concentration of fenac after three months, while less than 7% of the initial fenac was degraded after 3 months in the unsupplemented water. In contrast, unsupplemented sewage had as much activity as supplemented lake water while supplemented sewage showed the loss of fenac within 1 week and after 3 months nearly 40% of the compound has been degraded. Less than 2% of the chemical was lost in sterile samples of lake water and sewage. Fenac was degraded, albeit slowly in certain systems, and this degradation is dependent on high cell densities and the ecosystem used. Herbicides with a chlorine in the meta position are generally resistant to microbial degradation and apparently transformation of fenac to an aromatically intact metabolite is easier than ring cleavage. (Baker-IVI)
W84-04543

MOBILIZATION OF AZAARENES FROM WASTEWATER TREATMENT PLANT BIOSLUDGE,
Oak Ridge National Lab., TN. Environmental Sciences Div.
G. R. Southworth, and J. L. Keller.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 4, p 445-452, April, 1984. 2 Fig, 2 Tab, 16 Ref.

Descriptors: *Landfills, *Sludge disposal, *Water pollution sources, *Azaarenes, Wastewater treatment, Aromatic compounds, Quinoline, Acridine, Benz(a)acridine, Dibenz(a,h)acridine, Leaching, Path of pollutants, Partition coefficients.

The possible presence of azaarenes in residues disposed of in landfills represents a potential source of groundwater contamination. The partitioning behavior of a homologous series of azaarenes was examined between water and a wastewater sludge under conditions representing both neutral and cationic species of the aromatic bases. Large differences in sorption were observed among the four compounds: quinoline, acridine, benz(a)acridine, and dibenz(a,h)acridine. The partitioning of azaarenes between organic rich sludge and water appears to be dominated by the mechanism of hydrophobic partitioning. Low molecular weight azaarenes (2-3 rings) are readily leached from organic rich sludge, while under acidic conditions the mobilization of larger compounds becomes more significant. The large amount of lime and ferric chloride used to stabilize and flocculate the sludge would ensure the presence of alkaline conditions initially upon disposal. Leaching of the inorganic bases and generation of carbon dioxide and organic acids as the sludge degrades could act to promote the eventual establishment of a low pH environment within a disposal site. The mobility of azaarenes outside the disposal site will be determined in part by the sorption of the compounds by soil receiving the leachate from a disposal site. (Baker-IVI)
W84-04546

SPILL OF METHYL PARATHION IN THE MEDITERRANEAN SEA: A CASE STUDY AT PORT-SAID, EGYPT,
National Research Centre, Cairo (Egypt). Water Pollution Control Lab.
M. I. Badawy, M. A. El-Dib, and O. A. Aly.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 4, p 469-477, April, 1984. 3 Fig, 2 Tab, 16 Ref.

Descriptors: *Methyl parathion, *Port-Said, *Egypt, *Mediterranean Sea, Fate of Pollutants, Fish, Sediments, Water analysis, Insecticides, Spills.

More than 1000 kg of methyl parathion entered the Mediterranean Sea as a result of a collision of two ships in February of 1982, near the north entrance of the Suez Canal at Port-Said. The concentration of methyl parathion in sediments, fish samples, and sea water taken from the area is reported. The follow up of the distribution of methyl parathion concentration at the various sampling sites indicated that the prevailing meteorological conditions have an influence in drifting the spilled insecticide towards the south-west direction. Uptake of methyl parathion was subject to variation according to fish species concerned, time of exposure and the concentration of insecticide in water. (Baker-IVI)
W84-04548

A BACTERIOLOGICAL ASSESSMENT OF THE MERSEY ESTUARY AND NORTH WIRRAL COAST, UK,
Stockport Metropolitan Borough Council, Chester (England). Environmental Health Dept.
E. J. Dillon, and B. Henderson-Sellers.
Water, Air, and Soil Pollution, Vol. 22, No. 3, p 241-255, April, 1984. 4 Fig, 1 Tab, 13 Ref.

Descriptors: *Bacteria, *Estuaries, *River Mersey, *North Wirral Coast, *England, Bioindicators, Water pollution sources, Industrial wastes, Municipal wastewater, Escherichia, Coliforms, Salmonella.

The River Mersey and its Estuary are assessed for the effects of pollution by use of biological indicators. A sampling program for certain bacteria indicates that there is often gross pollution, athough there is a wide range of observed values on both short time and space scales. This study considers bacteriological contamination in order to supplement existing survey data on heavy metals, dissolved oxygen, biochemical oxygen demand and suspended solids. The upper section of the estuary receives considerable quantities of sewage effluent and industrial waste. The initial sampling program was designed to investigate the incidence of total coliforms, Escherichia coli, Salmonella, and antibiotic resistant bacteria. Sludge dumping in Liverpool Bay has had only insignficant effects on coliform levels studied here. The tidal Mersey receives 39 crude industrial discharges, 54 crude water authority discharges as well as the effluent from industry and sewage works via tributaries and the Manchester Ship Canal. Samples from the estuary

showed high readings of E. coli. The contribution of E. coli and salmonella organisms from shipboard sewage is very difficult to assess. (Baker-IVI)
W84-04561

METAL COMPOSITION OF SOIL SEDIMENTS, AND URBAN DUST AND DIRT SAMPLES FROM THE MENOMONEE RIVER WATERSHED, WISCONSIN,
California Univ., Davis. Dept. of Land, Air and Water Resources.
A. Dong, G. Chesters, and G. V. Simsiman.
Water, Air and Soil Pollution, Vol. 22, No, 3, p 257-275, April, 1984. 2 Fig, 8 Tab, 17 Ref. Environmental Agency Grant R005142.

Descriptors: *Metals, *Soil, *Sediments, *Urban dust, *Menomonee River Watershed, *Wisconsin, Menomonee River, Path of pollutants, Fate of pollutants, Particle size, Particle shape, Vehicular emission, Chemical properties, Bottom sediments.

The Al, Cd, Cr, Cu, Fe, Mn, Ni, Pb, and Zn contents of the sand, silt, and clay fractions were determined for soils, urban street dust and bottom- and suspended-sediments sampled in the Menomonee River watershed, Wisconsin. The samples were dispersed by ultrasound prior to fractionation. The ultrasound dispersion avoids chemical contamination or alteration resulting from use of chemical dispersants and insures the dispersion of aggregates present in mechanically-sieved samples. Chemical analyses of fractionated samples were more precise than analyses of unfractionated samples in identifying areas in the watershed receiving pollutant inputs. Higher levels of Cr, Cu, Fe, and Ni were found in the coarser particles than in the finer particles of urban street dust samples. The Cd, Pb, and Zn contents of some bottom and suspended sediments were greater than in the soils of the watershed. Contents of these metals were correlated significantly with each other in the clay-sized fraction of sediments but not in soils. The metal contents of sediments were largely controlled by vehicular emission. (Author's abstract)
W84-04562

RETENTION AND RELEASE OF CHEMICAL SPECIES BY A NORTHERN MICHIGAN SNOWPACK,
General Motors Research Labs., Warren, MI. Environmental Science Dept.
S. H. Cadle, J. M. Dasch, and N. E. Grossnickle.
Water, Air and Soil Pollution, Vol. 22, No. 3, p 303-319, April, 1984. 7 Fig, 7 Tab, 10 Ref.

Descriptors: *Snowpack, *Chemical properties, *Michigan, Snowmelt, Hydrogen ion concentration, Water pollution sources, Acidic water, Cations, Anions, Ions, Snow sampling, Runoff, Little Pigeon River, McNearney Lake.

The rapid release of acids from snowpack during the spring thaw can cause a temporary drop in the pH of poorly buffered lakes and streams. Snow-core and water samples were collected during the 1981 to 82 winter at two independent sites in Northern Michigan; the Little Pigeon River and McNearney Lake. Acidic and basic species were determined in all samples. Examination of the concentration vs depth profiles of snow cores showed that all species were stable in the snowpack until the spring thaw period. During the thaw, 50 to 70% of the stored acids were released during the first 20% of the snowmelt. However, rainfall during the melt period contributed as much acidity to the environment as the snowmelt. The runoff showed that only 30% of the nitrate originally present in the snowpack appeared in the Little Pigeon River. Therefore, H_2SO_4 dominated the runoff acidity at the Little Pigeon River. Both nitrate and sulfate were responsible for the slight acidification of McNearney Lake during the snowmelt period. (Murphy-IVI)
W84-04564

DESCRIBING THE TRANSPORT OF ION-EXCHANING CONTAMINANTS USING AN EFFECTIVE KD APPROACH,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
A. J. Valocchi.
Water Resources Research, Vol. 20, No. 4, p 499-503, April, 1984. 4 Fig, 1 Tab, 15 Ref.

Descriptors: *Ion exchange, *Distribution coefficient, *Solute transport, Mathematical equations, Groundwater pollution, Water pollution sources, Fate of pollutants, Simulation model.

The fate of many inorganic and organic contaminants in groundwater systems is strongly influenced by ion exchange and sorption reactions. Hydrogeologists have traditionally used distribution coefficients Kd to describe the rate of migration of sorbing contaminants. Recent investigations have questioned the validity of the Kd approach for contaminants governed by multicomponent ion exchange and have noted that computed Kd values in such cases are not constant across an advancing solute front. This report demonstrates that mass balance arguments can nevertheless be utilized to define a constant 'effective' Kd which may then be used to calculate the contaminant front velocity. For selected cases of one-dimensional binary and ternary exchange, front locations calculated using the effective Kd approach is also applied to a field problem involving the injection of advanced-treated municipal effluent into a shallow confined aquifer. Although the effective Kd approach is sometimes a practically useful tool, it is shown to be limited to situations where dispersion can be neglected. (Murphy-IVI)
W84-04574

EFFECT OF CROPPING, SUMMERFALLOW AND FERTILIZER NITROGEN ON NITRATE-NITROGEN LOST BY LEACHING ON A BROWN CHERNOZEMIC LOAM,
Department of Agriculture, Swift Current (Saskatchewan). Research Station.
C. A. Campbell, R. DeJong, and R. P. Zentner.
Canadian Journal of Soil Science, Vol. 64, No. 1, p 61-74, February, 1984. 5 Fig, 5 Tab, 22 Ref.

Descriptors: *Environmental effects, *Cropping, *Summerfallow, *Fertilization, *Nitrogen, *Leaching, *Brown Chernozemic loam, Soil organic matter, Soil porosity, Soil properties.

In 1982, six crop rotation treatments that were initiated in 1967 on a Orthic Brown Chernozemic loam were sampled for soil NO3-N and moisture to a depth of 240 cm. Soil samples were taken on 18 May and 10 June from all treatments, on 2 Sept. on fallow treatments only, and on 14 Oct. from cropped treatments. Precipitation during the sampling period was about 23% above the long-term average. It was estimated that at least 123 kg NO3-N/ha were leached from the top 240 cm of fallow soils. Leaching appeared to result from a portion of the precipitation moving through macro soil pores. There was evidence that water and NO3-N might also move upwards from below the 240-cm depth. Of the six rotations examined, the 2-yr and 3-yr spring wheat (Triticum aestivum L.) rotations lost the most NO3-N. The presence of fall rye (Secale cereate L.) in a fallow-rye-wheat rotation was very effective in reducing NO3-N losses. Spring wheat, when grown continuously, was also very effective in reducing NO3-N losses but even here there was some evidence of leaching beyond the root zone. Application of fertilizer N and P at amounts based on soil test recommendations reduced NO3-N leached. It was estimated from long-term precipitation data, that over the past 100 yr about 20% of the soil organic N that was present at the time of breaking the land has been lost from the soil via leaching. It was concluded that leaching losses of N from the soils on the Canadian prairies had been greatly underestimated and were partly responsible for losses attributed to the more visible wind erosion. (Author's abstract)
W84-04577

A NEW APPROACH TO PREDICTING THE DISPERSION OF A CONTINUOUS POLLUTANT SOURCE (UNE NOUVELLE DEMARCHE POUR LA PREDICTION DE LA DISPERSION D'UNE SOURCE DE POLLUTION CONTINUE),
Canterbury Univ., Christchurch (New Zealand).
A. J. McNulty, and I. R. Wood.
Journal of Hydraulic Research, Vol. 22, No. 1, p 23-34, 1984. 4 Fig, 2 Tab, 6 Ref.

Descriptors: *Path of pollutants, *Model studies, Dispersion, Rivers, Predicting, Estimating, Mixing, Nonuniform flow, Turbulence.

In order to assess the potential impact of the release of a pollutant in a river, it is necessary to determine the pollutant concentration downstream of the release point. A new approach to diffusion of a continuous source has enabled non-uniform conditions to be modelled. As a first step towards a better understanding of the mixing from a continuous source, this study considers a continuous line source in a wide channel. An algorithm has been developed to obtain the complete downstream concentration distribution for any turbulent shear flow. This enables the more realistic logarithmic velocity and parabolic diffusivity distributions to be used. The results are compared with those obtained using assumptions that the longitudinal concentration gradients are negligible and that the velocity and diffusivity are both constant over the depth. (Baker-IVI)
W84-04588

TRANSVERSE MIXING IN OPEN CHANNEL FLOW,
Karlsruhe Water Resources Agency (Germany, F.R.).
G. Webel, and M. Schatzmann.
Journal of Hydraulic Engineering, Vol. 110, No. 4, p 423-435, April, 1984. 7 Fig, 1 Tab, 22 Ref.

Descriptors: *Tranverse mixing, *Open-channel flow, Rectangular open-channel flow, Smooth open-channel flow, Rough open-channel flow, Cooling water, Plumes, Mathematical models, Hydrodynamics.

The prediction of cooling water or wastewater dispersion in rivers requires an accurate treatment of the far field region of the plume. An experimental study motivated by dimensional analysis was carried out to investigate the variation in the transverse mixing coefficient in straight, rectangular, smooth, and rough open channel flows. The findings have led to a number of suggestions relating to the future laboratory simulations of prototype cooling-water or wastewater dispersion in a river. The mixing coefficient is essentially a 'catch-all' parameter lumping together the combined effects of turbulent diffusion, secondary flow, and dispersion due to nonuniformity of the transverse velocity profile. Turbulent diffusion is by far the major contributor to this coefficient. The increase in the tranverse mixing coefficient can be explained by the fact that in hydraulically smooth turbulent flows, the scale of the energy containing eddies is larger than in hydraulically rough but otherwise identical open channel flows. Recognizing that the basic transport mechanism for pollutant dispersal in rivers is turbulent diffusion, model/prototype-similarity requires an undistorted model to ensure that large eddies be represented in a geometrically similar manner between field and laboratory; and the same friction factor to be maintained to assure that similar amounts of energy are supplied from the time-mean flow into the underlying turbulent system. (Murphy-IVI)
W84-04590

SNAIL MARISA CORNUARIETIS IN TROPICAL HYDROELECTRIC RESERVOIRS,
World Health Organization, New York. Blue Nile Project in Sudan.
For primary bibliographic entry see Field 2H.
W84-04596

SALT EFFLORESCENCE IN PRICE RIVER BASIN,
New Mexico Water Resources, Santa Fe.
B. K. Rao, D. S. Bowles, and R. J. Wagenet.
Journal of Environmental Engineering, Vol. 110, No. 2, p 457-471, April, 1984. 6 Fig, 2 Tab, 27 Ref. OWRT project B-172-Utah, grant 14-34-0001-9099.

Descriptors: *Salt efflorescence, *Price River basin, Saline water intrusion, Salinity, Saline soils, Water pollution sources, Fate of pollutants.

Salt efflorescence has been hypothesized to be an important nonpoint source of salinity in the Price River basin which is a major salt contributor, relative to its contribution of water, to the Colorado River system. Efflorescent salt loading was investigated through field studies, aerial photography, laboratory experiments, and mathematical modeling. The conditions favorable to the formation of salt efflorescence crusts are highly saline soil water near the soil surface and a source of heat above the soil for evaporating the soil water. Field data indicate that the salt efflorescence crust forms over the first 10-15 days after a storm runoff washes off the earlier efflorescence. After this period, the efflorescence crust apparently acts as a physical barrier to further soil water evaporation. Observation from aerial photography suggest that the major source of salt for efflorescence is the water that infiltrates saline geological formations and returns to ephemeral streams with dissolved salts. An expected value of salt efflorescence crust density at the time of a storm was computed by fitting an exponential probability distribution for the time interval between consecutive summer storms in the Price River basin. This density, which was estimated as 1.40 kg/sq m, was used with an average number of four storms per year and the fraction of the total basin area underlain by marine Mancos shale to obtain the estimate that salt efflorescence contributes approximately 8.5% of the total salt loading in the Price River basin. It was assumed that all the salt efflorescence crust is washed off during each storm, and that no salt is leached back into the soil. Therefore, the foregoing percentage may be expected to be an upper bound estimate. Also, it neglects efflorescent salt loading outside the summer season. This study adds to the previous studies in the Price River basin in concluding that the surface salt sources produce a relatively small fraction of the total loading. This conclusion suggests that subsurface sources of salt pickup are significant and future salt loading studies in the basin should consider subsurface processes. (Murphy-IVI)
W84-04600

NUTRIENT CYCLING IN AN AGRICULTURAL WATERSHED: II. STREAMFLOW AND ARTIFICIAL DRAINAGE,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
R. R. Lowrance, R. L. Todd, and L. E. Asmussen.
Journal of Environmental Quality, Vol. 13, No. 1, p 27-32, January-March, 1984. 4 Fig, 2 Tab, 23 Ref. NSF grants DEB 78-10841 and DEB 82-07210.

Descriptors: *Agricultural watersheds, *Streamflow, *Drainage water, *Nutrient cycling, Water pollution sources, Nitrogen, Phosphorus, Calcium, Potassium, Chloride, Sulfates, Seasonal variation, Sediment load.

Streamflow is an important means of nutrient export off most watersheds. In agricultural areas, effluent from artificial drainage can be an important contribution to streamflow nutrient loads. The objective of this study was to examine seasonal variations of nutrients in streamflow and to quantify the effects of artificial drainage effluent on streamflow nuturients on an agricultural watershed. Concentrations and loads of NO3-N, NH4-N, organic N, dissolved molybdate-reactive P, total P, Ca, Mg, K, Cl, and SO4-S were measured in streamflow and artificial drainflow on a 1568-ha agricultural watershed near Tifton, Ga. All 10 streamflow sampling sites had maximum NO3-N and SO4-S concentrations in winter and most reached minima during summer. Concentrations of NO3-N, Ca, Mg, Km and Cl were generally much higher in drainage water than streamflow. Load of NO3-N from drained row-crop fields was about 40.4 kg/ha/y, 60 times the per-hectare NO3-N load from the mixed cover watershed. Loads of organic N, Ca, Mg, K, SO4-S, and Cl from the mixed cover watershed were 2.8, 9.3, 4.5, 6.5, 17.0, and 30.0 kg/ha/y, respectively. Loads (per hectare) of organic N were lower from the drained fields, but loads of Ca, Mg, K, SO4-S, and Cl were from the mixed cover watershed. In-stream and riparian zone processes apparently converted inorganic N to organic forms and removed N through denitrification. Annual streamflow N load was about 29% of the precipitation input of 12.2 kg/ha/y. Sediment-associated N and P loads in streamflow were 0.35 and 0.09 kg/ha/y, respectively, accounting for 9.0 and 8.5% of total N and P, respectively. The two highest flow events for the year carried 19% of the total annual flow and 19% of the annual sediment load, but had 30 and 27% of the total annual sediment N and P loads, respectively. This enrichment of sediment-associated N and P indicated that part of this sediment load moved directly from upland areas. (Author's abstract)
W84-04602

A TURBULENT-TRANSPORT MODEL FOR CONCENTRATION FLUCTUATIONS AND FLUXES,
Aeronautical Research Associates of Princeton, Inc., NJ.
R. I. Sykes, W. S. Lewellen, and S. F. Parker.
Journal of Fluid Mechanics, Vol. 139, p 193-218, 1984. 12 Fig, 31 Ref, 1 Append.

Descriptors: *Turbulent flow, *Model studies, Plumes, Sediment transport, Path of pollutants, Mathematical equations.

Most of the more fundamental theoretical methods present very severe problems in their extension to non-homogenous or time-dependent turbulent fields, so that some intermediate is required. The second-order closure framework provides such a level, in that more of the physical processes are contained within the equations than with eddy-diffusivity models, but the equations are still considerably simpler than a spectral closure. A second-order closure model describing the diffusion of a passive scalar from a small source is presented. The model improves upon earlier ones in that attention has been paid to the early stages of the release to ensure that correct behavior is modelled. The model as presented predicts the linear and parabolic regimes of the mean-concentration profile growth without any new empirical constraints, and compares well with experimental data. The main restriction is that each release must be treated separately. Any requirement from the specification of time-dependent diffusivities has been removed by allowing all the turbulence correlations to diffuse at the same rate as the mean concentration in the early stages. This closes the system of equations, allowing the closure model to completely determine the solution in terms of the background turbulence parameters. The new model also contains an equation for the evolution of the scalar variance. (Baker-IVI)
W84-04603

HEAVY METAL DISPERSION PATTERNS FROM TAILINGS DUMPS, NORTHAMPTON DISTRICT, WESTERN AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Floreat Park (Australia). Div. of Mineralogy.
A. W. Mann, and M. Lintern.
Environmental Pollution (Series B), Vol. 6, No. 1, p 33-49, 1983. 7 Fig, 4 Tab, 7 Ref.

Descriptors: *Heavy metals, *Drainage systems, *Northampton, *Australia, *Mine wastes, Leaching, Water pollution sources, Fate of pollutants, Chapman River, Bowes River, Murchison River, Western Australia.

Dispersion of heavy metals into drainage systems of the Chapman, Bowes and Murchison Rivers occurs as a result of sediment transport and leaching from tailings dumps in the Northamptom Mineral District, Western Australia. Anomalous heavy metal values occur in stream sediments up to 20 km from their source. Lead shows the most widespread distribution and concentrations in excess of 1000 microg/liter Pb occur in stream waters close to contaminant sources. Development of acidity is restricted because of the high pH (7.0-9.0) of natural groundwaters in the region, and the predominance of sulphides of lead and zinc over those containing iron. (Author's abstract)
W84-04616

HEAVY METAL BURDEN IN WATER, SUBSTRATE, AND MACROINVERTEBRATE BODY TISSUE OF A POLLUTED RIVER IRWELL (ENGLAND),
Brock Univ., St. Catharines (Ontario). Dept. of Biological Sciences.
S. S. Dixit, and D. Witcomb.
Environmental Pollution (Series B), Vol. 6, No. 3, p 161-172, 1983. 5 Fig, 1 Tab, 20 Ref.

Descriptors: *Heavy metals, *Fate of pollutants, *Water quality, *Substrates, *Macroinvertebrates, *Tissue analysis, Asellus, Erpobdella, Oligochaetes, Chironomids, Bioindicators, Bioaccumulation.

The River Irwell macroinvertebrate fauna is suffering from heavy metal pollution. Atomic absorption spectrophotometry shows high levels of zinc, copper, and lead in the substrate matter and the invertebrates (Asellus, Erpobdella, oligochaetes and chironomids). A linear relationship exists between the substrate heavy metal levels and that of invertebrates. Oligochaetes and chironomids show highest levels of metal accumulations, while Erpobdella and Asellus accumulate moderate to low levels of metals in their bodies. In invertebrates, the metal accumulation rates are dependent on their mode of association with the substrate and their physiological ability to excrete the metals. In comparison with substrate matter and invertebrates, the river water contains low metal levels. This is most probably due to the slightly alkaline (pH 7-6) nature of the river which precipitates an increased load of metals. (Author's abstract)
W84-04619

OBSERVATIONS ON HEAVY METAL GEOCHEMICAL ASSOCIATIONS IN POLLUTED AND NON-POLLUTED ESTUARINE SEDIMENTS,
Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
M. A. Badri, and S. R. Aston.
Environmental Pollution (Series B), Vol. 6, No. 3, p 181-193, 1983. 2 Fig, 3 Tab, 24 Ref.

Descriptors: *Heavy metals, *Geochemistry, *Estuaries, *Sediments, Chemical composition, Nonlithogenous fractions.

The total concentrations and the geochemical associations in surface sediments from three estuaries in northwest England have been studied. The estuaries represent varying degrees of pollution, and the present results indicate rather different behavior among the metals and the sites investigated. The distribution of the metals in the 'easily or freely leachable and exchangeable', 'oxidizable-organic', 'reducible' and 'resistant' fractions of the sediments were determined by a sequential leaching technique. For all metals, the resistant fraction was dominant, especially for iron. Among the other (non-lithogenous) fractions the oxidizable organic fraction was frequently important. (Author's abstract)
W84-04620

ARSENIC, GOLD AND MERCURY CONCENTRATION LEVELS IN FRESHWATER FISH BY NEUTRON ACTIVATION ANALYSIS,
Benin Univ., Benin City (Nigeria). Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W84-04621

FATE OF PENTACHLOROPHENOL IN ESTUARINE SEDIMENT,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
R. D. DeLaune, R. P. Gambrell, and K. S. Reddy.
Environmental Pollution (Series B), Vol. 6, No. 4, p 297-308, 1983. 4 Fig, 2 Tab, 9 Ref.

Descriptors: *Fate of pollutants, *Pentachlorophenol, *Estuaries, *Sediments, Hydrogen ion concentration, Oxidation-reduction potential, Degradation, Chemical degradation, Louisiana, Coastal waters, Shell Beach.

The fate of pentachlorophenol (PCP) following a major spill in a Louisiana Gulf Coast estuary was examined. Degradation of PCP was strongly influenced by sediment pH and oxidation-reduction potential conditions. Degradation rates decreased with decreasing sediment oxidation-reduction potential. Maximum degradation occurred at pH 8.0. Adsorption/desorption studies show PCP to be more tightly bound to oxidized sediment than to reduced sediment. The measured degradation rates suggest that microbial degradation could account for the observed disappearance of residual PCP in the spill area. (Author's abstract)
W84-04622

FATE AND DISTRIBUTION OF THE MOTH-PROOFING AGENTS DIELDRIN AND EULAN WA NEW IN LOCH LEVEN, KINROSS, 1964-1979,
Freshwater Fisheries Lab., Pitlochry (Scotland).
D. E. Wells, and A. A. Cowan.
Environmental Pollution (Series B), Vol. 7, No. 1, p 11-33, 1984. 4 Fig, 7 Tab, 14 Ref.

Descriptors: *Fate of pollutants, *Dieldrin, *Eulan WA New, *Loch Leven, *Kinross, Bioaccumulation, Sediment, Pesticides, Scotland.

Following the cessation of the use of dieldrin in 1963 and the subsequent use of Eulan WA New at the textile mill in Kinross, Scotland, the fate and distribution of the mothproofing agents in the Loch Leven environment were studied. Fish samples analyzed between 1963 and 1970 showed a decline in dieldrin concentrations with a half-life of 0.56-0.82 years (r greater than 0.87). Samples of water, sediment, zooplankton and fish were taken for analysis during 1978-1979. About 50% of the Eulan WA New remained in the soluble ionic form and was discharged into the River Leven. Much of the remaining 50% was associated with particulate matter and sediment. Less than 10% was associated with the biota. The samples were analyzed using GC-ECD and GC-MS-DS with decachlorobiphenyl as the internal standard. (Author's abstract)
W84-04623

NITROGEN FERTILISATION AND NITRATE POLLUTION OF GROUNDWATER IN SANDY SOILS,
Ghent Rijksuniversiteit (Belgium). Faculteit Landbouwwetenschappen.
M. K. Yusop, O. Van Cleemput, and L. Baert.
Environmental Pollution (Series B), Vol. 7, No. 1, p 43-48, 1984. 1 Fig, 2 Tab, 10 Ref.

Descriptors: *Nitrogen, *Fertilization, *Groundwater pollution, *Sandy soils, Infiltration, Nitrates, Denitrification, Leaching, Belgium.

The study of the relation between N fertilization and groundwater pollution was carried out on two fields in the sandy area of Belgium during a two-year period. The fields under study were grown with maize and barely and received fertilizer N and manure at normally applied rates. The NO3(-)-N and Cl(-) content of the groundwater at 0.5, 1.0, 1.5 and 2.0 m depth was monitored every two weeks. The total rainfall during the two consecutive years was about 800 mm. On one of the fields, the NO3(-)-N content at all depths was mostly above 11.3 mg NO3(-)-N d/cu m, the WHO safe limit. However, on the other field the nitrate level was much lower, except at 0.5 m depth. The difference between the two fields was attributed to differences in the rate of N input. The fluctuations during the two-year study were influenced by N fertilization and rainfall distribution. The NO3(-)-N/Cl(-) ratio indicated that denitrification in the deeper zones of the soil was not prominent. (Author's abstract)
W84-04624

FLUORIDE RETENTION IN HIGHLY LEACHED DISTURBED SOILS,
Newcastle Univ. (Australia). Dept. of Biological Sciences.
F. Murray.
Environmental Pollution (Series B), Vol. 7, No. 1, p 83-95, 1984. 2 Fig, 5 Tab, 28 Ref.

Descriptors: *Flouride, *Retention, *Leaching, *Disturbed soil, Soil structure, Iron, Aluminum, Soil physical properties, Soil chemistry.

The fluoride retention capacity of highly leached disturbed soil, possessing little soil structure, was examined by applying fluoride to soil cores in cylinders and subjecting them to leaching for 12 months. Even at very high fluoride application rates only 2.6 to 4.6% of the fluoride applied was leached as water-soluble fluoride. The pH of the eluate increased with increasing mass of fluoride applied to the columns, probably as a result of fluoride adsorption by exchange with OH(-) from soil metal hydroxides. During the course of the experiment the water-soluble fluoride content of the soils decreased due to an enhancement of the firmness of the link between the surfaces of soil particles and fluoride, which occurs with time. Both water-soluble and total fluoride concentrations were found to be greatest at a depth of 0.7 to 1.4 m. It was concluded that soil iron and aluminum compounds may be the major fluoride retention factors in this soil, although other soil physical and chemical factors may also be involved. These reconstituted soils possess a very high capacity to retain fluoride despite their high permeability and relative absence of structure. (Author's abstract)
W84-04626

CESIUM-137, METALS AND ORGANIC CARBON IN THE SEDIMENTS OF THE JAMES RIVER ESTUARY, VIRGINIA,
Old Dominion Univ., Norfolk, VA. Dept. of Oceanography.
G. T. F. Wong, and C. S. Moy.
Estuarine, Coastal and Shelf Science, Vol. 18, No. 1, p 37-49, January, 1984. 4 Fig, 4 Tab, 43 Ref. NOAA grant NA-80-FA-D-0007.

Descriptors: *Cesium-137, *Copper, *Lead, *Zinc, *Organic carbon, *Sediments, James River estuary, Subenvironments, Metals, Radioactive tracers, Radioactive dating, James River, Virginia.

A wide variety of sedimentary subenvironments are found within a 10-km stretch of James River including a flood dominated channel (Rocklanding Channel) and its bank (Rocklanding Shoal), a shoal with a water depth of 1 m separating two channels (Point of Shoals), an ebb-dominated channel (Burwell Bay Channel) and its bank (Burwell Bay Bank) and a tributary (Warwick River). The concentrations of Cs-137, Cu, Pb, Zn and organic carbon in the fine-grained sediments (i.e. less than 63 microm) and the amount of fine-grained sediments in eight cores covering these subenvironments were determined. The sedimentation rates, estimated by Cs-137 geochronology, range from 0.4 to greater than 3 cm/year. The sedimentation rates in the Burwell Bay region are two or more times those in the Point of Shoals and in the Rocklanding Channel and Shoal, reflecting the weaker currents in the Burwell Bay region. These sedimentation rates agree well with those obtained independently by measuring changes in the bathymetry of this area between 1873 and 1943. The concentrations of Cs-137, Cu, Pb, Zn and organic carbon in surface sediments vary by a factor of two to three. The concentrations are higher in the Burwell Bay region, probably as a result of the higher rates of accumulation of recently formed sediments in these subenvironments. The inventories of fine-grained sediments and of Cs-137, Cu, Pb, Zn and organic carbon accumulated since 1954 are also up to an order of magnitude higher in the Burwell Bay region. Although the concentrations of fine-grained sediments in three cores obtained in this region are similar, the inventories still vary by a factor of two to three. The inventories of Cs-137, Cu, Pb, Zn, organic carbon and fine-grained sediments correlate well with each other indicating that Cs-137 can be a useful tracer for studying the fate of these metals and organic carbon in estuarine environments. The inhomogeneity of the concentrations and inventories of the different elements along a 10-km segment of a river suggests that a closely-spaced sampling program is essential for characterizing the sedimentary provinces within an estuary. The concentrations of Cs-137, metals and organic carbon in the coarse-grained sediments (i.e. greater than 63 microm) are considerably lower than those in fine-grained sediments. Thus, the contribution of coarse-grained sediments to the total inventory of these elements is small. (Author's abstract)
W84-04630

TOTAL SELENIUM AND SELENIUM (IV) IN THE JAMES RIVER ESTUARY AND SOUTHERN CHESAPEAKE BAY,
Old Dominion Univ., Norfolk, VA. Dept. of Oceanography.
K. Takayanagi, and G. T. F. Wong.
Estuarine, Coastal and Shelf Science, Vol. 18, No. 1, p 113-119, January, 1984. 5 Fig, 38 Ref.

Descriptors: *Selenium, *James River estuary, *Chesapeake Bay, James River, Salinity, Chemical properties, Mixing, Geochemistry.

The concentrations of total selenium (Se) and Se (IV) were determined in the surface waters of 30 stations located in the James River and southern Chesapeake Bay. The concentrations of total Se and Se (IV) ranged from 0.28 to 1.91 nM and from 0.07 to 1.36 nM, respectively, between salinities of 31.78 and 0.06 0/00. The concentration of Se (VI), calculated as the difference between the concentrations of total Se and Se (IV), ranged from 0.08 to 0.67 nM. While total Se seemed to be conservative in this study area at salinities above 0.36 0/00, Se (IV) might have been removed during estuarine mixing. The removal of Se (IV) occurred primarily at salinities below 4 0/00 possibly via the oxidation of Se (IV) to Se (VI). (Author's abstract)
W84-04632

POLYCHLORINATED BIPHENYLS (PCBS) IN THE MARINE ENVIRONMENT, PARTICULARLY IN THE MEDITERRANEAN,
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Okologische Chemie.
H. Geyer, D. Freitag, and F. Korte.
Ecotoxicology and Environmental Safety, Vol. 8, No. 2, p 129-151, April, 1984. 1 Fig, 17 Tab, 109 Ref.

Descriptors: *Polychlorinated biphenyls, *Marine environment, *Mediterranean, Bioaccumulation, Sediments, Microplankton, Algae, Mussels, Fish, Marine organisms, Sea birds, Water pollution.

Polychlorinated biphenyls (PCBs) possess a low water solubility, a high n-octanol/water partition coefficient, and a high persistence, particularly those which are highly chlorinated. Because of these properties they are bioaccumulated in many organisms in the environment. PCBs are still manufactured industrially and used in the Mediterranean countries (e.g., Italy, Spain, and France). The concentrations of PCBs in marine air, water, sediments, microplankton, algae, mussels, fish and other marine organisms including seabirds from the Mediterranean area are reviewed and compared with PCB concentrations in marine samples from non-Mediterranean regions. Levels of PCBs in seawater are highest in the western and central Mediterranean. The data for mussels and fish give a clear indication that the PCB levels are higher in the Northwest and the Tyrrhenian Sea than in the eastern Mediterranean. The FDA in June 1979 set 2 mg/kg as the temporary maximum concentrations for PCBs in fish and shellfish. The PCB residues in some fish from the northwestern Mediterranean and Tyrrhenian Sea and in some mussels from the Adriatic Sea are higher than this limit. The amount of PCBs ingested via food by the Mediterranean population is unknown. (Murphy-IVI)
W84-04637

FATE OF ANTHRACENE IN AN ARTIFICIAL STREAM: A CASE STUDY,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
P. F. Landrum, S. M. Bartell, J. P. Giesy, G. J. Leversee, and J. W. Bowling.
Ecotoxicology and Environmental Safety, Vol. 8, No. 2, p 183-201, April, 1984. 3 Fig, 8 Tab, 23 Ref. Department of Energy contract DOE-AC09-76SR00819.

Descriptors: *Fate of pollutants, *Anthracene, *Artificial stream, *Polycyclic aromatic hydrocarbons, Water pollution effects, Degradation, Sinks, Toxicity, Hydrocarbons, Model studies.

The fate of anthracene, a representative polycyclic aromatic hydrocarbon, was followed in a large outdoor stream microcosm. The major nonadvective route for the removal of anthracene was photolytic degradation to anthraquinone (half-life 43 min). The anthraquinone also photolyzed rapidly in this shallow stream system. Excluding the plastic channel liner, the sediment acts as the major sink for anthracene, absorbing 0.2% of the 14-day input dose. The periphyton community was the second most important sink, absorbing 0.04% of the input dose. All other compartments were of significantly less importance on a mass basis. Anthracene (11 microg/liter) caused photoinduced 100% mortality of the bluegill sunfish in 9 hr in the upstream reach. Fish at the downstream station survived for approximately 26 hr and all died within 1 hr of each other. Other organisms, clams and dragonfly larvae, started to die off toward the end of the 14-day input period. (Author's abstract)
W84-04638

A GENERAL STOCHASTIC MODEL FOR PREDICTING BOD AND DO IN STREAMS,
North Carolina Univ. at Charlotte. Dept. of Mathematics.
S. D. Damaskos, and A. S. Papadopoulos.
International Journal of Environmental Studies, Vol. 21, No. 3/4, p 229-237, October, 1983. 7 Fig, 10 Ref.

Descriptors: *Stochastic process, *Biochemical oxygen demand, Dissolved oxygen, Streams, Predicting, Forecasting, Oxygen, Sedimentation, Absorption, Path of pollutants, Model studies.

The stochastic model presented in this study is a random differential equation. The solution process is discussed. An example and computation are given indicating how the results may be used to study the statistical properties of the biochemical oxygen demand (BOD) and dissolved oxygen (DO) processes at any point down the stream from a source of pollution. It is assumed that there are five major activities in the stream: the pollution and dissolved oxygen are decreased by bacterial action; the dissolved oxygen is increased due to the process of reaeration at a rate proportional to the DO deficit; the BOD is only decreased by sedimentation and absorption at a rate proportional to the amount of pollution present; the pollution is increased from small sources along the stretches of stream; and the DO is decreased at a given rate in ppm per day. (Baker-IVI)
W84-04657

THE ABUNDANCE OF AU, PT, PD, AND THE MODE OF HEAVY METAL FIXATION IN HIGHLY POLLUTED SEDIMENTS FROM THE RHINE RIVER NEAR MAINZ, WEST GERMANY,
Mainz Univ. (Germany, F.R.).
C. B. Dissanayake, K. Kritsotakis, and H. J. Tobschall.
International Journal of Environmental Studies, Vol. 22, No. 2, p 109-119, January, 1984. 4 Fig, 3 Tab, 28 Ref. Deutsche Forschungsgemeinschaft grant 53/11.

Descriptors: *Heavy metals, *Pollutants, *Sediments, *Rhine River, *Mainz, *West Germany, *Gold, *Lead, *Platinum, *Ginsheimer-Altrhine River, Fate of pollutants, Industrial wastes, Water pollution, Pollution load.

The Au, Pt, and Pd contents of the sediments of Ginsheimer-Altrhine River, a channel of the Rhine river which drains one of the most industrialized regions of western Europe, have been determined by flameless atomic absorption spectrophotometry. The abundances of these noble metals range from 96-460 ppb Au; 734 ppb-31 ppm Pt and 32 ppb-4 ppm Pd. The extremely high concentrations, particularly those of Pt and Pd, are attributed to their use in industry and are due to the formation and concentration of metal-organic complexes, mainly at the interface between an extremely reducing and an oxidizing aquatic environment. Differential thermal analyses of the polluted sediments in comparison to the pure humic acid and Fe-humate complex show that humic and fulvic acids are of great importance in the transport of heavy metals in polluted stream sediments. (Author's abstract)
W84-04662

A NON-EQUILIBRIUM APPROACH TO MODELING METAL SPECIATION IN ACID, AQUATIC SYSTEMS: THEORY AND PROCESS EQUATIONS,
Savannah River Ecology Lab., Aiken, SC.
T. D. Fontaine, III.
Ecological Modelling, Vol. 21, No. 4, p 287-313, March, 1984. 10 Fig, 5 Tab, 43 Ref. Department of Energy contract DE-AC09-76SR00819.

Descriptors: *Mathematical equations, *Algorithms, *Metals, *Aquatic environment, Chemical speciation, Speciation, Heavy metals, Ion exchange.

A general algorithm (NONEQUI) was developed to simulate reversible sorption and ion exchange kinetics among a variety of heavy metals and substrates in acid (pH less than 6.5) lake or stream environments. Competitive metal-substrate and substrate-substrate interactions are modeled as kinetic processes rather than invoking an instantaneous equilibrium assumption. This distinction from other models offers certain advantages when attempting to predict the fate, speciation, transport and ultimately biological effects of toxic metals in dynamic media such as lakes and streams. (Author's abstract)
W84-04676

INPUT-OUTPUT BUDGETS AT LANGTJERN, A SMALL ACIDIFIED LAKE IN SOUTHERN NORWAY,
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 2H.
W84-04695

DILUTION AND ACIDIFICATION EFFECTS DURING THE SPRING FLOOD OF FOUR SWEDISH MOUNTAIN BROOKS,
National Swedish Environment Protection Board, Solna.
For primary bibliographic entry see Field 2E.
W84-04697

TRACE METALS IN SWEDISH NATURAL FRESH WATERS,
National Swedish Environment Protection Board, Solna.
H. Borg.
Hydrobiologia, Vol. 101, No. 1/2, p 27-34, April, 1983. 9 Fig, 4 Tab, 10 Ref.

Descriptors: *Trace metals, *Sweden, *Natural water, Hydrogen ion concentration, Acidity, Cadmium, Lead, Aluminum, Manganese, Zinc, Comparison studies, Humic substances, Water color.

Water samples were collected from unpolluted waters in southern and northern Sweden to show the range of natural trace metal concentrations. The results do not indicate any significant differences in metal levels between the two study areas. Negative correlations with pH exist for total concentrations of Cd, Pb, Al, Mn and Zn. The dissolved (dialysable) metal fractions also increase with increasing acidity. The concentration of humic substances influences the distribution of Fe, Mn, Al, Pb, Cr, Co and As, as shown by positive correlations with water color. Increasing alkalinity has a limiting effect upon concentrations and annual fluctuations of Cd, and Pb, and to some extent on Zn, in running waters. (Author's abstract)
W84-04698

ORIGIN AND PRODUCTION OF PHOSPHATASES IN THE ACID LAKE GARDSJON,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
H. Olsson.
Hydrobiologia, Vol. 101, No. 1/2, p 49-58, April, 1983. 8 Fig, 2 Tab, 10 Ref.

Descriptors: *Phosphorus compounds, *Acidic lakes, *Gardsjon Lake, *Acid water, Phosphatases, Hydrogen ion concentration, Chemical properties, Forest hydrology.

The activity of acid phosphatases was followed for one year in Lake Gardsjon as well as in the inlet and the outlet of the lake. A budget of the phosphatases was calculated, including an estimation of the production of phosphatases. The phosphatase activity was also measured in two basins upstream of L. Gardsjon: the north basin and the south basin of L. Stora Hastevatten. The acid phosphatase activity was very high compared with reported alkaline phosphatase activities in other lakes. About 95% of the phosphatases in L. Gardsjon was produced in the lake, and the production was highest in early summer. Small Chrysophyceae (< 10 microm) probably produced the majority of the acid phosphatases in the investigated lakes, and accordingly could be favored in environments with low phosphorus supply due to their ability to produce large amounts of phosphatases. (Author's abstract)
W84-04700

HEAVY METAL INDICATOR POTENTIAL OF THE ASIATIC CLAM (CORBICULA FLUMINEA) IN ARTIFICIAL STREAM SYSTEMS,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
R. L. Graney, Jr., D. S. Cherry, and J. Cairns, Jr.
Hydrobiologia, Vol. 102, No. 2, p 81-88, June, 1983. 1 Fig, 2 Tab, 28 Ref. Department of Energy contract E-(40-1)-4939.

Descriptors: *Heavy metals, *Asiatic clam, *Corficula, *Artificial streams, *Bioindicators, Bioaccumulation, Cadmium, Copper, Zinc.

The potential of the Asiatic clam, Corbicula fluminea, as a bioindicator of cadmium, copper, and zinc was studied during 28-day exposures in field artificial streams, receiving river water on a once-through basis. Copper, at aquatic concentrations of 0.016 and 0.057 mg/l, showed the greatest degree of tissue uptake and had bioconcentration factors (BCF) of 22,571 and 17,720, respectively. A significant correlation (coefficient = 0.639) was observed between water concentration and tissue accumulation. Cadmium was intermediate relative to BCF (3,770 and 1,752 at aquatic exposures of 0.023 and 0.055 mg/l, respectively), and had a correlation coefficient of 0.758. Zinc had the lowest potential for concentration (631, 358, and 511 BCF at 0.218, 0.433, and 0.835 mg/l, respectively) with a correlation coefficient of 0.478. The rate of accumulation in Corbicula reached a maximum after 11 days of cadmium while a steady state condition for copper was not observed in 28 days. Zinc accumulation, like copper, showed a relative increase throughout the 28-day exposure period. Data from this study show that the Asiatic clam may be a reliable indicator of uptake for exposure to selected heavy metals. (Author's abstract)
W84-04717

A COMPARISON OF STREAMS IN LOGGED AND UNLOGGED AREAS OF GREAT SMOKY MOUNTAINS NATIONAL PARK,
National Park Service, Omaha, NE. Midwest Region.
D. G. Silsbee, and G. L. Larson.

Hydrobiologia, Vol. 102, No. 2, p 99-111, June, 1983. 3 Fig, 11 Tab, 27 Ref.

Descriptors: *Logging, *Comparison studies, *Great Smoky Mountains National Park, Water quality, Benthic macroinvertebrates, Detritus, Debris dams, Debris basins, Macroinvertebrates, Benthos.

Second order streams draining areas of virgin forest in Great Smoky Mountains National Park, Tennessee and North Carolina, U.S.A., are compared to those which drain forests logged before the establishment of the park in the 1930's. Water quality of two main study streams (one unlogged and one formerly logged) was compared and the unlogged stream had generally higher levels of dissolved solids and lower levels of suspended particulates than the logged stream. Stream channel characteristics were compared on four logged and four unlogged streams. The unlogged streams had over four times more (by volume) of woody debris and 10 times more material in debris dams than the logged streams. Only minor differences in substrate composition were observed. Macroinvertebrate samples from the four logged and four unlogged streams showed that the logged streams contained greater numbers of organisms and more taxa. More detailed sampling on the two main study streams showed similar patterns of more individuals and more taxa in the logged stream, as well as differences in the composition of five functional groups. These differences in invertebrate fauna may be due to differences in quantity and quality of leaf litter inputs, although other explanations are also possible. (Author's abstract)
W84-04719

EFFECT OF RETURN WATER FROM IRRIGATED RICE FIELDS ON THE SALINITY OF WATER IN THE KILIA BRANCH OF THE DANUBE,
Central Research Inst. on the Multipurpose Use of Water Resources, Kiev (USSR).
R. G. Zadorozhnaya.
Hydrobiological Journal, Vol. 19, No. 2, p 69-75, 1983. 2 Fig, 3 Tab, 6 Ref.

Descriptors: *Water pollution sources, *Salinity, *Irrigation-return flow, *Danube river, Water use, Irrigation, Mixing, Rice, Salinity, Seasonal variation.

The dilution of the saline return waters from the Kilia and Liski irrigated rice areas and the salinity of the diluted water before its intake into the Liski and Vilkovo municipal water systems were determined. The width of the water-mixing band is calculated. The low dilution of the winter return waters from the rice fields, and especially of summer return waters above Liski and Vilkova Town is due to the fact that only a part of the Danube water participates in the dilution process. The dilution of the summer return waters from the Kilia Rice Irrigation System (RIS) above Liski involves only 14% and that of winter return waters only 34% of the total water flow in the Solomon arm of the Danube. The corresponding values at Vilkovo are 31 and 62% of the total flow in the Kilia arm. The salinity of Danube water during the vegetative and cold periods increases, but only in the mixing band. The discharge of return water from the Kilia and Liski RIS in the direct vicinity of Liski and Vilkova is undesirable. (Baker-IVI)
W84-04727

COMPLEXING OF METAL IONS IN NATURAL WATERS,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
P. N. Linnik, and B. I. Nabivanets.
Hydrobiologia, Vol. 19, No. 3, p 71-85, 1983. 1 Fig, 4 Tab, 92 Ref.

Descriptors: *Complexing, *Metals, *Ions, *Natural waters, *Literature review, Organic compounds, Chemical properties, Mathematical equations, Humic substances, Inorganic compounds.

In recent years exhaustive sutdies have been undertaken to determine the state of metal ions in natural waters, including theri complexing. The results are extremely important both in scientific explanation of the physiological effect of metals on aquatic organisms and in the solution of a number of practical problems. Some of which concern the development of effective measures for the removal of metals from potable and industrial waters, the development of hydrochemical techniques of search for minerals, prediction of the chemical composition of natural waters polluted by industrial and agricultural effluents. A review of the literature on complexing of metal ions in natural waters is presented. Complexing properties of compounds most characteristic of natural waters, and the mechanisms of metal ion binding to form complexes are discussed, as are various techniques for studying complexing. Stability constant logarithms are given for complexes of metals with humic substances and other organic compounds of natural origin. Complexing affects a large fraction of metals present in natural water, enhancing their mobility and their ability to migrate in solution. Fresh water metal complexes were predominately humic substances, whereas seawater metal complexes were predominately inorganic forms. (Murphy-IVI)
W84-04734

COMPLEXATION OF COPPER BY AQUATIC HUMIC SUBSTANCES FROM DIFFERENT ENVIRONMENTS,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2K.
W84-04740

ACCUMULATION OF CADMIUM BY ABARENICOLA PACIFICA,
Oregon State Univ., Corvallis. Dept. of Civil Engineering.
S. M. Oakley, K. J. Williamson, and P. O. Nelson.
The Science of the Total Environment, Vol. 28, p 105-118, June, 1983. 8 Fig, 2 Tab, 35 Ref.

Descriptors: *Cadmium, *Bioaccumulation, *Abarenicola, Trace metals, Bioavailability, Geochemistry, Kinetic models, Sediments, Seawater, Path of pollutants.

The bioavailability of trace metals to marine organisms depends on trace metal partitioning among geochemical phases and on the kinetics of uptake from each phase. This study was undertaken to develop a kinetic model for trace metal uptake based on equilibrium partitioning of the metal in aqueous and sedimentary phases. A three compartment model was developed and used to estimate the accumulation of cadmium under short term laboratory conditions. The rate of cadmium uptake from bentonite clay, humic acid, ferric hydroxide, and seawater was measured for the deposit-feeding polychaete Abarenicola pacifica. The results show that, under the conditions of this study, bentonite clay and ferric hydroxide can be more important sources of cadmium than seawater for Abarenicola pacifica. (Author's abstract)
W84-04743

FATES OF METAL RADIOTRACERS ADDED TO A WHOLE LAKE: ACCUMULATION IN SLIMY SCULPIN (COTTUS COGNATUS) AND WHITE SUCKER (CATOSTOMUS COMMERSOND),
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
J. F. Klaverkamp, M. A. Turner, S. E. Harrison, and R. H. Hesslein.
The Science of the Total Environment, Vol. 28, p 119-128, June, 1983. 5 Fig, 4 Tab, 13 Ref. NSF grant OCE 75-15105.

Descriptors: *Radioisotopes, *Radioactive tracers, *Bioaccumulation, Fate of pollutants, Sculpin, Sucker, Radioactive wastes, Iron radioisotopes, Zinc radioisotopes, Selenium radioisotopes, Cesium radioisotopes, Mercury radioisotopes.

The gamma-emitting isotopes, iron-59, cobalt-60, zinc-65, selenium-75, cesium-134 and mercury-203, were added in mid-summer to Lake 224 of the Experimental Lakes Area in northwestern Ontario. This experiment was part of a larger program of limnological investigations on radioisotopes of heavy metals present in industrial and nuclear power effluents. Isotope activities in whole bodies of slimy sculpins and in blood, gills, gut contents, kidney, liver and spleen of white suckers were determined for periods up to 247 days after isotope addition. Results demonstrate delay between contamination of a lake and transfer of contaminant to these fish species. General relationships between movement and distribution of isotopes in water and their accumulation in these fish indicate that direct accumulation from water is not a major route of uptake. Direct evidence supporting food as the major route of uptake is lacking, because feeding behavior of these species was not studied and gut contents were not analyzed to identify biological organisms. (Moore-IVI)
W84-04744

MIGRATION OF RADIOCONTAMINANTS IN A FORESTED WETLAND ON THE CANADIAN SHIELD: NUCLIDE SPECIATION AND ARBOREAL UPTAKE,
Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
E. L. Cooper, and J. O. McHugh.
The Science of the Total Environment, Vol. 28, p 215-230, June, 1983. 4 Fig, 6 Tab, 10 Ref.

Descriptors: *Wetlands, *Radioactive wastes, *Path of pollutants, Groundwater pollution, Cobalt radioisotopes, Strontium radioisotopes, Cesium radioisotopes, Bioavailability, Trees, Forests, Radioactive waste disposal, Ontario.

Nuclide speciation and arboreal uptake have been studied in a forested wetland adjacent to a radioactive waste management area at the Chalk River Nuclear Laboratories in Ontario, Canada. A variety of speciation techniques has revealed the presence of anionic species of several radionuclides in the groundwater. In particular, Co-60 exists in solution throughout the wetland predominantly in a very stable, anionic and hydrophilic form. Studies of the concentration of radionuclides in tree sap have shown that there are similarities in the variations in uptake of Co-60, Sr-90 and Cs-137 with time during the Spring. An experiment using bean plants grown in solution culture with contaminated groundwater spiked with cationic Co-57, demonstrated that the anionic forms of Co-60 were less bioavailable than the more labile and cationic forms of cobalt in solution. (Author's abstract)
W84-04746

DISSOLVED AND PARTICULATE METAL CHEMISTRY OF THE CENTRAL AND EASTERN BASINS OF LAKE ERIE,
National Water Research Inst., Burlington (Ontario).
K. R. Lum, and J. K. Leslie.
The Science of the Total Environment, Vol. 30, p 99-109, September, 1983. 1 Fig, 5 Tab, 34 Ref.

Descriptors: *Lake Erie, *Metals, *Particulates, Aluminum, Cadmium, Cobalt, Iron, Manganese, Nickel, Lead, Zinc, Seasonal variation, Lake sediments, Phytoplankton, Decomposition, Eutrophication.

Dissolved and particulate forms of Al, Cd, Co, Cu, Fe, Mn, Ni, Pb and Zn were determined in the Central and Eastern Basins of Lake Erie during May, August and September 1978. No temporal or spatial differences in the average concentrations of dissolved Cu, Ni, Al and Fe were observed between May and September. In contrast, Mn and Zn showed significant seasonal variations with Mn having distinct concentration maxima in both basins during September. This behavior is attributed to net release of Mn and Zn from the bottom sediments. Phytoplankton activity is shown to be important in causing large increases (1.8-5.4 times the concentrations in May) in particulate elemental concentrations during the bloom periods. The removal of Cu, Ni, Pb and Zn from the water column is mediated by the decay of plankton populations. (Author's abstract)
W84-04749

THE SIGNIFICANCE OF ATMOSPHERIC DEPOSITION OF HEAVY METALS IN FOUR DANISH LAKES,
Aarhus Univ. (Denmark). Botanical Inst.
V. J. Larsen.
The Science of the Total Environment, Vol. 30, p 111-127, September, 1983. 3 Fig, 7 Tab, 45 Ref.

Descriptors: *Heavy metals, *Atmospheric deposition, *Lakes, *Denmark, Water pollution sources, Zinc, Copper, Lead, Cadmium, Aquatic plants, Sediments, Macrophytes, Oligotrophic lakes.

The atmospheric deposition rate of heavy metals was determined throughout a seventeen month period at four lakes and a control station across Mid-Jutland, Denmark, and its significance was assessed in relation to the concentrations of Zn, Cu, Pb, and Cd in water, sediment and aquatic macrophytes (Phragmites australis (Cav.) Trin, Littorella uniflora (L.) Ashers., Isoetes lacustris L. and Juncus bulbosus L.) from Lake Hampen, Lake Meldgaard, Lake Sorteso, and Lake Godstrup. Mean annual deposition rates of 1.81-2.77 mg Cu/sq m, 4.09-8.73 mg Pb/sq m, and 0.21-0.37 mg Cd/sq m were determined. For Zn a mean deposition rate of 15 mg Zn/sq m/year was used. The atmospheric deposition per sq m of Zn and Cu amounts to 0.2-37%, 0.05-4.3% and 3.4-107% of the contents present in the water column of the lakes, the upper 10 cm of the littoral sediment and in dense vegetation of aquatic macrophytes, respectively. Equivalent figures for Pb and Cd are 1.8-649%, 0.8-30.6%, and 16.8-951%. In the profundal sediments of the oligotrophic Lake Hampen, post-war atmospheric deposition has increased the heavy metal concentration and content up to 180 times. The Pb concentrations in sediments from different depths were significantly correlated with the post-war consumption of gasoline in Denmark. It is concluded that atmospheric deposition of heavy metals results in a significant contamination of lakes, especially oligotrophic lakes for which aerial fallout is the major source. It is further concluded that lake sediments uncontaminated with heavy metals are probably no longer found in Denmark. (Author's abstract)
W84-04750

CADMIUM ADSORPTION IN FRESHWATERS - A QUANTITATIVE APPRAISAL OF THE LITERATURE,
Edinburgh Univ. (Scotland). Dept. of Geology.
D. P. H. Laxen.
The Science of the Total Environment, Vol. 30, p 129-146, September, 1983. 5 Fig, 6 Tab, 55 Ref.

Descriptors: *Cadmium, *Adsorption, Literature reviews, Hydrogen ion concentration, Suspended sediments, Iron oxides, Clays, Silica, Humic substances, Manganese oxides, Sediments.

Information from 33 studies of cadmium, adsorption on amorphous and crystalline hydrous iron oxides, clays, silica, humic solids, manganese oxides and natural sediments has been collated. The results have been transferred to a unified data base using a surface complexation model, and are presented in terms of conditional adsorption constants as a function of pH. The adsorption constants for a given substrate at a fixed pH generally agree with an order of magnitude. This is reasonable given the wide range of experimental conditions employed. The affinity of the substrates (on a weight basis) for cadmium appears to follow the order Mn > Fe am > chlorite (montmorillonite) > Fe cryst = illite = humics > kaolinite > silica. Application of the experimental conditional adsorption constants for the individual substrates to a model suspended sediment predicts adsorption levels similar to those found in experiments with real sediments. The results confirm the potentially important role played by hydrous oxides of iron and manganese. They also emphasize that cadmium is in a very dynamic regime with respect to adsorption in many freshwaters. Deficiencies in our present information on cadmium adsorption are highlighted and suggestions made for future studies. (Author's abstract)
W84-04751

PREDICTIVE ACCURACY DETERMINATION APPLIED TO A LINEAR MODEL PHOSPHORUS LOADING RESULTING FROM URBAN RUNOFF,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
R. F. Malone, H. Saidi, and K. Wegener.
Applied Mathematical Modelling, Vol. 8, No. 2, p 81-88, April, 1984. 7 Fig, 3 Tab, 14 Ref.

Descriptors: *Mathematical models, *Urban runoff, *Phosphorus, Pollution load, Simulation, Prediction, Storm runoff, Water quality.

A case study of the application of an iterative technique for determination of predictive accuracy is presented. The method uses Monte Carlo simulations and split sampling techniques to verify model accuracy. Examination of the ability of a linear parametric runoff loading model's ability to project total phosphorus loadings reveals the sensitivity of the model to calibration procedures. Predictive reliability was found to vary widely as the number of rainfall events considered in the calibration process changed. Predictive reliability was substantially increased by imposing calibration constraints which ensured that a wide distribution of values of the independent variable were represented in the calibration pool. Although the linear model is theoretically weak in its representation of the runoff loading phenomenon, it displays relatively stable predictive capabilities which warrant its consideration for use in management studies. The predictive errors associated with loading projections limit the linear model's value to applications insensitive to errors in the loading projections for individual storm events. This study provides further evidence of the need to consider uncertainties associated with the modelling of water quality phenomena. (Author's abstract)
W84-04768

5C. Effects Of Pollution

POPULATION BIOLOGY IN THE COURTROOM: THE HUDSON RIVER CONTROVERSY,
Oak Ridge National Lab., TN.
L. W. Barnthouse, J. Boreman, S. W. Christensen, C. P. Goodyear, and W. Van Winkle.
BioScience, Vol. 34, No. 1, p 14-19, January, 1984. 2 Fig, 1 Tab, 30 Ref.

Descriptors: *Decision making, *Model studies, *Hudson River, *Population dynamics, Fish populations, Bass, Environmental effects, Planning, Management, Direct impact assessment, Legislation.

The Hudson River controversy was a unique test of the ability of biologists to use their science to aid public decision makers in achieving an equitable solution to an important environmental problem. Some of the successes and failures of this effort are evaluated, based on years of experience of technical advisors and expert witnesses for the various federal agencies involved in the case. The major issue of the study was the use of mathematical models of fish populations as environmental assessment tools. The first attempt to quantify the impact of water withdrawals on the Hudson River striped bass population was based on a simple comparison of the average daily water withdrawal by the Cornwall facility to the average daily tidal flow of the Hudson. Various models were presented to make the analysis more correct, but the issue of entrainment impacts on striped bass had not been satisfactorily dealt with. This resulted in a remarkable proliferation of entrainment models as agency and utility scientists competed to produce the more realistic models. Each of the many settlement proposals discussed by the negotiators included a package of mitigating measures aimed at reducing the impact of entrainment on the fish. It seems certain that decisions about the need to mitigate the environmental impacts of man's activities will often have to be made on the basis of incomplete information, rather than being deferred indefinitely in the hope that scientists will come up with definitive solutions. (Baker-IVI)
W83-04283

INADEQUACY OF DIVERSITY INDICES IN DISCERNING METAL MINE DRAINAGE EFFECTS ON A STREAM INVERTEBRATE COMMUNITY,
Chadwick and Associates, Littleton, CO.
J. W. Chadwick, and S. P. Canton.
Water, Air and Soil Pollution, Vol. 22, No. 2, p 217-223, 1984. 2 Fig, 1 Tab, 24 Ref.

Descriptors: *Diversity indices, *Metal mine drainage, *Invertebrates, Bioindicators, Measuring instruments, Mine drainage, Water pollution sources, Water pollution effects.

Diversity indices have long been used to assess impacts on stream invertebrate communities. By providing a single value, they allow rapid comparisons between stations without long species lists, density estimates and other parameters that can confuse the non-biologist. The benthic invertebrates of the Dolores River in southwest Colorado were sampled during three seasons in an area of historic mine drainage. Benthic density exhibited significantly lower values below the mine drainage. However, the number of species did not decrease significantly, indicating that the effect of the mine drainage was primarily non-selective (i.e. favoring no one taxon). This pattern was seasonal with the least effects evident in summer and the greatest effects found in spring. Diversity indices used to assess the effects of this stress on the invertebrate community were Margalef's, Simpson's, Shannon-Weaver's, Brillouin's, and the Biotic Condition Index. None of the indices tested adequately responded to a decreasing trend in the benthic density when number of species remained constant. The indices did respond to a combination of low density and number of species. Diversity indices appear to be inadequate in assessing a non-selective stress. (Murphy-IVI)
W84-04212

SIGNIFICANCE OF WATER QUALITY TO FISH PROPAGATION, WATERFOWL HABITAT, LIVESTOCK WATERING, AND RECREATION USE FOR 24 LAKES AND RESERVOIRS IN VALLEY AND PHILLIPS COUNTIES, MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
R. F. Ferreira.
Available from the OFSS, USGS, Lakewood, CO 80225, Price: $8.25 paper copy, $3.50 in microfiche. USGS Water-Resources Investigations Report 83-4008, April 1983. 58 p, 2 Fig, 16 Tab, 37 Ref.

Descriptors: *Reservoirs, *Fish, *Waterfowl, *Livestock, *Swimming, *Water quality, Management planning, Lakes, Algae, Phytoplankton, Trace elements, Nutrients, Dissolved solids, Dissolved oxygen, Eutrophication, Toxicity, Fishkill, Water quality criteria, Valley County, Phillips County, *Montana.

Twenty-four reservoirs were sampled for water quality to determine their suitability for fish propagation, waterfowl habitat, livestock watering, and recreation. Reservoir-surface areas ranged from 0.2 to 146 hectares and depths ranged from 0.01 to 6.0 meters. Of the reservoirs studied, six generally had water quality that would not be detrimental to fish propagation. Most of the reservoirs were enriched with nutrients and supported large concentrations of phytoplankton and dense growth of aquatic plants. In late winter and late summer, enrichment of shallow reservoirs often resulted in dissolved-oxygen concentrations less than 5.0 milligrams per liter, which is detrimental to fish. Three reservoirs lacked aquatic plants for water fowl habitat. Four reservoirs had small dissolved-oxygen concentration in the bottom water that might be critical to the protection of waterfowl if botulism were to occur. Specific conductance of water samples from three reservoirs was sufficiently close to the criterion of 4,800 microsiemens per centimeter at 25 degrees celsius to be regarded as potentially hazardous to livestock. However, most of the reservoirs generally would not be conducive to recreational swimming. Visibility was limited in most of the reservoirs. In addition, leech populations and

growth of submersed aquatic plants in most of the reservoirs would be a nuisance to swimmers. (USGS)
W84-04258

WATER-QUALITY ASSESSMENT OF WHITE RIVER BETWEEN LAKE SEQUOYAH AND BEAVER RESERVOIR, WASHINGTON COUNTY, ARKANSAS,
Geological Survey, Little Rock, AR. Water Resources Div.
J. E. Terry, E. E. Morris, and C. T. Bryant.
Available from the Ofss, USGS Lakewood, CO 80225, Price: $15.00 paper copy, $15.00 microfiche. USGS Water Resources Investigations Report 82-4063, 1982. 107 p, 22 Fig, 13 Tab, 61 Ref.

Descriptors: *Dissolved oxygen, *Biochemical oxygen demand, Oxygen sag, *Nitrification, Model stimulation, Water pollution, Biological communities, Sources, Sinks, Rearation, *Arkansas, *White River, Fayetteville Wastewater-Treatment Plant, Dissolved oxygen deficit, Dissolved oxygen saturation, Kinetic reactions.

The Arkansas Department of Pollution Control and Ecology and U.S. Geological Survey conducted a water quality assessment be made of the White River and, that a steady-state digital model be calibrated and used as a tool for simulating changes in nutrient loading. The city of Fayetteville's wastewater-treatment plant is the only point-source discharger of waste effluent to the river. Data collected during synoptic surveys downstream from the wastewater-treatment plan indicate that temperature, dissolved oxygen, dissolved solids, un-ionized ammonia, total phosphorus, and floating solids and depositable materials did not meet Arkansas stream standards. Nutrient loadings below the treatment plant result in dissolved oxygen concentrations as low as 0.0 milligrams per liter. Biological surveys found low macroinvertebrate organism diversity and numerous dead fish. Computed dissolved oxygen deficits indicate that benthic demands are the most significant oxygen sinks in the river downstream from the wastewater-treatment plant. Benthic oxygen demands range from 2.8 to 11.0 grams per meter squared per day. Model projections indicate that for 7-day, 10-year low-flow conditions and water temperature of 29 degrees Celsius, daily average dissolved oxygen concentrations of 6.0 milligrams per liter can be maintained downstream from the wastewater-treatment plant if effluent concentrations of ultimate carbonaceous biochemical oxygen demand and ammonia nitrogen are 7.5 (5.0 5-day demand) and 2 milligrams per liter respectively. Model sensitivity analysis indicate that dissolved oxygen concentrations were most sensitive to changes in stream temperature. (USGS)
W84-04259

EFFECT OF SUBLETHAL AND LETHAL CONCENTRATIONS OF FENITROTHION, BHC AND CARBOFURAN ON BEHAVIOUR AND OXYGEN CONSUMPTION OF THE FRESHWATER PRAWN MACROBRACHIUM KISTNENSIS (TIWARI),
Poona Univ. (India). Dept. of Zoology.
K. R. Pawar, and M. Katdare.
Archive fur Hydrobiologie, Vol. 99, No. 3, p 398-403, February, 1984. 1 Tab, 24 Ref.

Descriptors: *Water pollution effects, *Pesticides, *Prawns, *Fenitrothion, *BHC, *Carbofuran, Organophosphates, Organochlorines, Carbamates, Behavior, Oxygen consumption, Toxicity.

The increased manufacture and use of pesticides for controlling crop pests and public health has posed a direct threat to water quality by contaminating aquatic systems. Environmental factors and stress alter the metabolic rates of animals as indicated by the rate of oxygen consumption. Such a change could indicate the effect of pesticides. The behavior and oxygen consumption of adult freshwater prawns, exposed to 96 hr LC50 sublethal and lethal concentrations of three pesticides Fenitrothion, BHC, and Carbofuran were studied. The prawns exposed to the sublethal concentrations showed an initial excitation for a period of 3 to 4 hrs after which they were apparently normal. The marked behavioral changes noted in the lethal concentrations of the pesticides were spontaneous movements, hyperactivity, loss of balance and finally paralysis. In the sublethal and lethal concentrations, prawns showed increased oxygen consumption up to 12 hrs and afterwards a decrease in oxygen consumption. (Baker-IVI)
W84-04279

POWER PLANT IMPACT ASSESSMENT: A SIMPLE FISHERY PRODUCTION MODEL APPROACH,
National Marine Fisheries Service, La Jolla, CA. Southwest Fisheries Center.
A. D. MacCall, K. R. Parker, R. Leithiser, and B. Jessee.
Fishery Bulletin, Vol. 81, No. 3, p 613-619, July, 1983. 1 Fig, 2 Tab, 21 Ref.

Descriptors: *Powerplants, *Environmental impact statement, *Model studies, *Fisheries, Cohort, Mathematical models, Mathematical equations, Fish populations, Mortality.

The relative abundance of a cohort affected by power plant entrainment mortality as a fraction (Rc) of the abundance of that cohort in the absence of power plant impact can be calculated by Rc = exp (Eiti) where ti is the duration of life stage i, and Ei is the entrainment mortality rate at stage i. Rate Ei can be estimated by the ratio of nonsurviving entrained organisms during a given time interval to the mean standing crop of stage i organisms in the source water during that interval. An estimate of adult abundance allows calculation of equivalent adult losses. When insufficient information is available to determine the long-term effect on the population, the fishery 'potential yield' formula provides an interim estimate. The methods may be separated into two somewhat independent analyses. The first is short-term assessment, which estimates entrainment impact on a single cohort in the sense of Goodyear's equivalent adult mortality. The second analysis estimates the long-term equilibrium impact of combined removals, including entrainment and impingement by one or more power plants, and all other nonnatural removals, including fishery harvests. As in the case of the 'potential yield' formula, the approximation of long-term equilibrium impact should be discarded when better estimates can be developed. (Murphy-IVI)
W84-04293

CHEMICAL AND TOXICITY ANALYSIS OF LEACHATES FROM COAL CONVERSION SOLID WASTES,
Pittsburgh Univ., PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W84-04326

INCIDENCE OF URBAN SEWAGE DISPOSAL IN THE SALT-PONDS AREAS OF THE SOUTH OF THE BAY OF CADIZ,
Cadiz Univ. (Spain). Dept. of Chemical Engineering.
D. Sales, A. Gomez, and D. Cantero.
Marine Pollution Bulletin, Vol. 14, No. 12, p 447-452, December, 1983. 9 Fig, 3 Tab, 10 Ref.

Descriptors: *Salt marshes, *Tidal effects, *Municipal sewage, *Cadiz, *Spain, Bay of Cadiz, Fish, Aquaculture, Toxicity, Fate of pollutants, Water pollution effects.

The highest pollution indices in the marsh and tidelands situated to the south of the Bay of Cadiz have been evaluated. The salt industry of the area is currently being transformed into mariculture installations. A systematic evaluation was made of different parameters at 26 sampling stations during the period 1976-1981. The quality of the water in the channels studied was adversely affected by urban sewage disposal. The diluting effect of tide water on the sewage diminished noticeably and progressively towards the central area of the study zone. Along the river Iro, there was an appreciable recovery of the watercourse as a result of the action of the tides and a certain amount of self-purification. It is particularly harmful that the sewage outlets from the towns are situated in the area of the meeting of the tides, where the waters are at their most stagnant or renewal is at its least. Different zones were established in the water basin on the levels of quality in the study areas. The results suggest that extensive zones are too seriously affected to make use of them as marine piscifactories. Prior treatment of the urban sewage, and the dredging of the principle channels of the zone may be solutions to the problem. (Baker-IVI)
W84-04328

CLAM BURROWING BEHAVIOUR: INHIBITION BY COPPER-ENRICHED SEDIMENT,
District of Columbia Univ., Washington.
H. L. Phelps, J. T. Hardy, W. H. Pearson, and C. W. Apts.
Marine Pollution Bulletin, Vol. 14, No. 12, p 452-455, December, 1983. 2 Fig, 2 Tab, 14 Ref. Department of Energy contract DE-AC06-76RLO 1830.

Descriptors: *Clams, *Behavior, *Copper, *Sediment, Bioindicator, Toxicity, Bioassay, Bioaccumulation.

Copper is one of the metals most toxic to marine life, but when it enters coastal waters the majority is sorbed by organic suspended material and transferred to sediments. This sorption decreases the cupric ion activity in water and reduces its bioavailability and toxicity to neritic life. Once copper accumulates on the sediment surface, little is known of its effects on infaunal benthos such as clams. Behavioral modification is one of the most sensitive indicators of environmental stress and may directly affect survival. Burrowing behavior is adaptive and allows clams to escape predation; yet the effects of potentially toxic metals on such behavior have not been adequately investigated. In natural marine sediment contaminated with copper the time for littleneck clams (Protothaca staminea) to achieve complete burial was recorded. Above a threshold of 5.8 microg/g Cu added to dry sediment, the time for 50% of the clams to burrow (ET50) increased logarithmically with increasing sediment copper concentration according to: logET50 = 0.15(Cu) - 1.37 (n = 4, sq r = 0.98) where ET50 = time in hours for 50% of clams to burrow and Cu = microg/g Cu in dry sediment. Previously exposed clams had both a lower threshold to Cu and a longer reburrowing time (ET50). Clams exposed to sediment mixed with Chelex-100-sorbed copper showed no significant changes in burrowing time. Bioassays based on clam burrowing behavior can measure both bioeffectiveness of sediment-sorbed metals and a sublethal effect with ecological meaning. (Murphy-IVI)
W84-04329

EFFECTS OF CHRONIC OIL POLLUTION FROM REFINERY EFFLUENT ON SEDIMENT MICROFLORA IN A DANISH COASTAL AREA,
Copenhagen Univ. (Denmark). Inst. for Spore Plants.
H. Gruttner, and K. Jensen.
Marine Pollution Bulletin, Vol. 14, No. 12, p 456-459, December, 1983. 4 Fig, 4 Tab, 16 Ref.

Descriptors: *Oil pollution, *Water pollution effects, *Sediments, *Microflora, *Denmark, *Coastal waters, Petroleum hydrocarbons, Oil refineries, Microbial degradation, Bacteria, Yeasts, Filamentous fungi, Kalundborg Fjord.

Kalundborg Fjord is a Danish marine area which has been heavily oil polluted by refinery effluent, leading to accumulation of petroleum hydrocarbons in the surface sediments. A study of the occurrence in the sediment of heterotrophic bacteria, yeasts and filamentous fungi has been carried out, and the physiological composition of the microbial community has been recorded. Though the abundance of oil-degrading microorganisms was significant, a correlation between the number of these and the oil content of the sediment could not be demonstrated. (Author's abstract)
W84-04330

ENVIRONMENTAL IMPACT IN SANDY BEACHES OF COPPER MINE TAILINGS AT CHANARAL, CHILE,
Universidad Caolica de Chile, Santiago. Facultad de Ciencias Biologicas.
J. C. Castilla.
Marine Pollution Bulletin, Vol. 14, No. 12, p 459-464, 1983. 5 Fig, 2 Tab, 17 Ref.

Descriptors: *Environmental impact statement, *Copper, *Mine wastes, *Chanaral, *Chile, Geomorphology, Macrofauna, Population exposure, Population density, Water pollution effects.

Since 1938, untreated copper mine tailings of Potrerillos and El Salvador have been disposed into the sea at Chanaral, Chile (26 degrees 21 min. Lat. S., 70 degrees 42 min. Long. W.). Over 220 x 10 to the 6th power tons of sediments have been dumped. This pollution has caused drastic geomorphologic changes in the c. 16 km contaminated area. The occurrence of new artificial beaches and modification of coastal contours are reported. Sandy beach macrofauna monitoring (1975-1982) demonstrated a progressive lowering of density and biomass in those communities affected by copper mine tailings. (Author's abstract)
W84-04331

THE MICROBIAL ECOLOGY OF THE BRISTOL CHANNEL,
Institute for Marine Environmental Research, Plymouth (England).
For primary bibliographic entry see Field 2L.
W84-04336

THE EFFECT OF PHOSPHATE ON BACTERIAL BIOMASS PRODUCTION IN WATERS OF LAKES OF THE JORKA RIVER DRAINAGE BASIN,
Polish Academy of Sciences, Lomianki. Inst. of Ecology.
W. A. Godlewska-Lipowa.
Polskie Archiwum Hydrobiologii, Vol. 30, No. 4, p 331-341, 1983. 1 Fig, 3 Tab, 43 Ref.

Descriptors: *Phosphate, *Bacteria, *Biomass production, *Jorka River, Productivity, Eutrophic lakes, Eutrophication, Cycling nutrients, Phosphorous, Microbial degradation.

Among the major nutrients, phosphorus comes second after nitrogen in covering the nutritional requirements of all organisms. The bacterial enzymic systems taking part in the metabolism of phosphorus compounds are very specific. Evaluation was made of the effect of inorganic and organic phosphate on the rate of bacterial biomass production in eutrophic lakes, greatly differing in the eutrophication degree. In surface waters, the bacterial biomass varied from a little over 1.0 g/cu dm in Majcz Wielki Lake to more than 5.0 g/cu dm in Glebokie Lake. The action of the phosphates studied proved to be non-equivalent, and their effect differed in dependence on lake and period of the vegetation season. In spring, bacterial biomass production attained - in the presence of lecithin and KH2PO4 - level of 0.160 and 0.185 g C/cu dm. 24 h, respectively. In case of the remaining phosphates, the respective values were somewhat lower. They were lowest for K2H PO4, amounting in spring in Majcz Wielki, Zelwazek and Jorzec Lake to 0.035, 0.111 and 0.139 g C/cu dm times 24 h, respectively. (Murphy-IVI)
W84-04341

FACTOR INTERACTIONS AND AQUATIC TOXICITY TESTING,
For primary bibliographic entry see Field 5A.
W84-04351

FISH IMPINGEMENT AT POWER STATIONS SITUATED ALONG THE RIVERS RHINE AND MEUSE IN THE NETHERLANDS,
Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands).
R. H. Haddenringh, G. H. F. M. van Aerssen, L. Groeneveld, H. A. Jenner, and J. W. van der Stoep.
Hydrobiological Bulletin, Vol. 17, No. 2, p 129-141, December, 1983. 5 Fig, 4 Tab, 18 Ref.

Descriptors: *Powerplants, *Impingement, *Fish, *Netherlands, *Rhine River, *Meuse River, Wall River, Beneden Merwede, IJssel River, Cooling water.

Impingement of fish in cooling water intakes of power stations can result in considerable mortalities. A sampling program was started in 1980 at six power stations on the rivers Wall, Beneden Merwede, IJssel, Meuse and Amer. The survey was confined to the impingement of juvenile and adult fish, that is, the blockage of fish against the fine cooling water screens. The entrained fraction, mainly fish larvae passing through the screens, pumps and condensers, was not considered. Substantial numbers of fish were impinged on the cooling water screens of Harculo, Gelderland, Merwedehaven and Amer power stations. Low numbers were impinged at the two stations located on the river Meuse. Possible reasons for this difference may be a low fish density in the river Meuse and the deep position of the cooling water intakes. In comparison with Bergum power station, situated on a lake, the impingement rate at the river stations was more than ten times as low. Most fish were impinged during the summer months when large numbers of juvenile fish are present in the rivers. Dominating species impinged were roach, pikeperch, bream and perch. The abundance of pikeperch in the screen samples, points to a recent increase in the population of pikeperch in the rivers. Thirty fish species and four crustacean species were collected, among which Orconectus limosus was quite abundant at Maas and Claus power stations. (Baker-IVI)
W84-04377

FOOD OF BLUEGILLS (LEPOMIS MACROCHIRUS) FROM HEATED AND UNHEATED AREAS OF A POWER PLANT COOLING RESERVOIR,
South Dakota Cooperative Fishery Research Unit, Brookings.
R. J. Krska, Jr., and R. L. Applegate.
Journal of Freshwater Ecology, Vol. 2, No. 4, p 325-334, April, 1984. 3 Fig, 2 Tab, 24 Ref.

Descriptors: *Powerplants, *Cooling ponds, *Fish, Bluegills, Thermal pollution, Heated water.

Bluegills collected from discharge (heated) and intake (unheated) areas of a power plant cooling reservoir in South Dakota in 1979 were opportunistic feeders. The relative contributions of the various food taxa to the bluegill diet reflected, in many instances, the relative abundances of potential food organisms in the reservoir. Consumption of zooplankton in both areas of the reservoir also generally followed seasonal zooplankton population changes, but was greatest in the discharge area. The seasonally important contribution of aquatic vegetation to the bluegill diet found in this study appeared related to the consumption of animal foods. The greater percentage of non-empty stomachs of bluegills collected in the discharge area appeared related to temperature differences between areas. Fish in heated waters were forced to feed more frequently to maintain their metabolic demands than fish from the intake, cooler, water area. Thus temperature and substrate for food organisms were dominant factors influencing food habits of Big Stone reservoir bluegills. (Baker-IVI)
W84-04382

IN-STREAM DISTRIBUTION AND HYDRAULIC AND ECOLOGICAL EFFECTS OF VOLCANIC ASH FROM MOUNT ST. HELENS ERUPTION,
Idaho Univ., Moscow. Dept. of Civil Engineering.
J. M. Milligan, C. M. Falter, and M. A. Brusven.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84169382, Price codes: A07 in paper copy, A01 in microfiche.
Idaho Water and Energy Resources Research Institute Completion Report, Moscow, October, 1983, 131 p, 40 Fig, 19 Tab, 108 Ref. Project No. OWRT C-10105-V (1466) (1), Contract/Grant No. 14-34-0001-1466.

Descriptors: Sediment transport, Sediment distribution, *Stream ecology, Aquatic environment, *Volcanic ash, Aquatic algae, Aquatic invertebrates, *Mount St. Helens, *Idaho, *Deposition (sediment).

The catastrophic eruption of Mt. St. Helens in southwestern Washington on May 18, 1980 deposited a plume of volcanic ash from Washington to western Montana. Ash deposits in northern Idaho were significant with depth varying from 2 to 3 mm in the fringes to as much as 50 mm in the central area of the plume as it crossed the Idaho panhandle. Varying amounts of the ash were deposited directly in streams located in the plume area. This study is an evaluation of the changes in the in-stream ecological conditions resulting from volcanic ash deposition and transport. This interdisciplinary evaluation of the in-stream effects of the new volcanic ash deposition on the physical and biotic components of streams in the ashfall plume area was studied by recreating, on a simulated basis, conditions prior to, during, and after the ash deposition, and by field verification measurements taken in the Palouse River to support the simulation studies. The results obtained from the simulation and field studies clearly indicate catastrophic influences of volcanic ash deposition and transport on attached benthic algae biomass and on the dislocation of invertebrates and interruption of food-chain relationships. While the shortterm impact was moderate to severe on selected populations, all of the principal species tested demonstrated considerable persistence and resilience such that long-term effects of the ash on the in-stream ecosystem are judged to be minimal.
W84-04405

SALINITY AND TEMPERATURE EFFECTS ON PHOTOSYNTHESIS AND ORGANIC CARBON RELEASE RATES BY SELECTED BENTHIC MACROALGAE,
Connecticut Univ., Storrs. Inst. of Water Resources.
For primary bibliographic entry see Field 2L.
W84-04407

EFFECTS OF ANURAN LARVAE ON AQUATIC PROCESSES ASSOCIATED WITH WATER QUALITY,
New Hampshire Univ., Durham. Water Resources Research Center.
For primary bibliographic entry see Field 5G.
W84-04410

MODELING OF WATER QUANTITY AND QUALITY FOR RIVER BASIN PLANNING,
New Hampshire Univ., Durham. Water Resources Research Center.
For primary bibliographic entry see Field 6A.
W84-04411

METALLOTHIONEIN INDUCTION, GROWTH, AND SURVIVAL OF CHINOOK SALMON EXPOSED TO ZINC, COPPER, AND CADIUM,
Victoria Univ. (British Columbia). Dept. of Biochemistry and Microbiology.
M. Roch, and J. A. McCarter.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 4, p 478-485, April, 1984. 1 Fig, 6 Tab, 13 Ref.

Descriptors: *Water pollution effects, *Salmon, *Campbell River, *British Columbia, *Metallothionein, Zinc, Copper, Cadmium, Heavy metals, Bioassay.

The hazards of metal contamination in the Campbell River to resident and transitory salmonids were explored by exposing chinook salmon eggs obtained from a hatchery to varying degrees of metal contamination. Determinations were made of survival and effects on growth and hepatic metallothionein concentration after long term exposures. Bioassays conducted after hatch, 4 weeks post hatch, and 8 weeks post hatch show greatest metal tolerance after hatch, least tolerance 4 weeks after

hatch and a slight increase in tolerance at the button-up stage. Metallothionein concentrations in whole alevins after 4 weeks of metal exposure do not show an increase as the synthesis of metallothionein occurs primarily in the liver, which is only 1% of the body weight of the fish. Hepatic metallothionein concentrations in chinook fry showed marked elevations in proportion to the metal concentrations to which the fish were exposed for 21 weeks. These extremely elevated concentrations reflect a marked biological response to the high concentrations of metals which are entering the fish. (Baker-IVI)
W84-04549

TOXICITY OF URANIUM TO DAPHNIA MAGNA,
Battelle Pacific Northwest Labs., Richland, WA. Environmental Sciences Dept.
T. M. Poston, R. W. Hanf, Jr., and M. A. Simmons.
Water, Air and Soil Pollution, Vol. 22. No. 3, p 289-298, April, 1984. 5 Tab, 14 Ref. U.S. Department of Energy contract DE-AC06-76RL0 1830.

Descriptors: *Toxicity, *Uranium, *Daphnia, Mine drainage, Mine wastes, Ions, Uranyl, Water pollution sources, Water pollution effects, Columbia River.

Mining and milling of uranium ore can result in the release of U to natural bodies of water. Standard treatment of mine waste water and mill tailing leachates by barium chloride precipitation and neutralization does not significantly reduce U concentrations. The toxicity of U to Daphnia magna was determined in acute and chronic tests. The 48-hr LC50 of U(VI) in Columbia River water was 6 mg/L. Acute toxicity diminished by a factor of 7.5 as mean water hardness and alkalinity values increased from 70 mg/L and 57 mg/L to 195 mg/L and 130 mg/L, respectively. This effect was most likely the result of complexation of uranyl ion with carbonate ions. D. magna reproduction was suppressed in Columbia River water at U concentrations between 0.5 and 3.5 mg/L. Potential hazards of U to aquatic life are discussed as they relate to mining practices. (Murphy-IVI)
W84-04563

BEHAVIORAL RESPONSE OF FISH TO ALTERED WATER QUALITY: A REVIEW OF SELECTED EXAMPLES WITH EMPHASIS ON SALMONIDS,
R. H. Gray.
Environmental Impact Assessment Review, Vol. 4, No. 1, p 84-96, March, 1983. 6 Fig, 2 Tab, 51 Ref. U.S. Dept. of Energy Contract DE-AC06-76RLO.

Descriptors: *Fish behavior, *Water quality, Heated water, Thermal pollution, Powerplants, Salmon, Fish migration, Avoidance, Water pollution effects, Chlorinated hydrocarbons.

The manner in which fish behavior can be modify by the effects of water quality alterations and the implications of this knowledge for assessing environmental effects and designing power generation facilities is described. Based on studies showing that adult migration delays are related to seasonally high ambient water temperatures, adult migrations are not blocked by midriver thermal discharges, and juveniles leave unfavorably high water temperatures, it can be concluded that given a choice, salmon avoid lethal temperatures. Tracking studies also show that adult salmon swim deeper in supersaturated water than in normally saturated water and thus avoid the critical zone and potentially lethal dissolved gas conditions. Fish also avoid chlorinated effluents. Assessment of environmental effects, design and operation of power generation facilities, and decisions regulating thermal and chlorine discharges should not be based solely on lab derived thermal and chemical tolerance data. Design and decisions should be based on an assessment process that considers adaptive behavior of key aquatic species at the site. The interaction of various environmental stimuli and their influence on fish response needs elucidation. Knowledge of the behavioral responses of aquatic organisms to water quality alterations puts thermal and chemical tolerance studies in perspective, and is essential to assessing potential environmental effects. Behavioral responses of organisms must be considered when designing and operating power generation facilities that affect aquatic systems. (Baker-IVI)
W84-04614

EFFECTS OF METALS AND SEDIMENT PARTICLE SIZE ON THE SPECIES COMPOSITION OF THE EPIFAUNA OF PINNA BICOLOR NEAR A LEAD SMELTER, SPENCER GULF, SOUTH AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Cronulla (Australia). Div. of Fisheries Research.
T. J. Ward, and P. C. Young.
Estuarine, Coastal and Shelf Science, Vol. 18, No. 1, p 79-95, January, 1984. 2 Fig, 6 Tab, 16 Ref.

Descriptors: *Metals, *Particle size, *Sediments, *Species composition, *Pinna, *Lead smelter, *Spencer Gulf, *Australia, Cadmium, Copper, Lead, Zinc, Bryozoa, Mollusks, Coastal waters, Bioaccumulation, Industrial wastes, Bioindicators, Population exposure, Water pollution effects.

Pinna bicolor (Mollusca: Pelecypoda) were transplanted between four sites near a lead smelter. The species composition of their epifauna (sessile and mobile) was examined in relation to characteristics of both sediments and seston at the sites. Seventy-two taxa were distinguished in the epifaunal community. Substantial differences were found in the short-term sensitivity of some of the species to concentrations of Cd, Pb and Zn in sediments and to sediment particle size. The short-term sensitivity of many species to metals or sediment particle size explained their long-term distribution pattern. Twenty-three taxa were identified as significantly characterizing the faunal differences. Of these, eleven (four mollusks, four bryozoans, two barnacles and one ascidian) were affected by both sediment metal concentrations and particle size, and eight (four mollusks, one bryozoan, one polychaete, one hydroid and one barnacle) were affected by metal contamination but not particle size. Of all fauna examined, the Bryozoa were the most metal-sensitive. Four species, Smittina raigii (Bryozoa), Galeolaria sp. 1 (Polychaeta), Epopella simplex (Cirripedia) and Monia ione (Pelecypoda) were identified by their short- and long-term sensitivity to metal contamination, and absence of sensitivity to sediment particle size, as suitable species for monitoring the effects of metal contamination on the epifauna. The implications of the results for toxicity-testing are discussed. (Author's abstract)
W84-04631

BIOCHEMICAL EFFECTS OF LONG-TERM EXPOSURE TO CADMIUM AND COPPER ON RAINBOW TROUT (SALMO GAIRDNERI): VALIDATION OF WATER QUALITY CRITERIA,
Genova Univ. (Italy). Ist. di Zoologia.
A. Arillo, D. Calamari, C. Margiocco, F. Melodia, and P. Mensi.
Ecotoxicology and Environmental Safety, Vol. 8, No. 2, p 106-117, April, 1984. 4 Tab, 47 Ref.

Descriptors: *Biochemical effects, *Long-term exposure, *Cadmium, *Copper, *Rainbow trout, *Water quality standards, Bioassay, Bioindicators, Blood catalase, Carbonic anhydrase, Liver aminolevulinate dehydrase, Leucylaminopeptidase, Mucus lysozyme, Sialic acid, Bioaccumulation.

Salmo gairdneri specimens were exposed for 4 months to 1-10 microg/liter of Cd and 30-100 microg/liter of Cu. At different times from the beginning of the experiment the activity of some metal-sensitive enzymes was assayed (blood catalase and carbonic anhydrase; liver aminolevulinate dehydrase and total leucylaminopeptidase). Under long-term exposure, a subsequent unbalance between mucus secretion and excretion occurs, leading to a depletion in sialic acid content and a consequent decrease in mucus chelator capacity. After 4 months of treatment - an impairment of important biochemical functions such as respiratory control ratio and oxygen consumption (state 3) in mitochondria and an alteration in lysosomal functions (increase in free LAP activity), carbonic anhydrase activity in blood, sialic acid content in gills, and ALA-D activity in liver for copper treatments at both WQC and 'effective' levels. It can be concluded that Cd WQC apparently are acceptable, whereas those for copper need to be revised. (Murphy-IVI)
W84-04635

PHYSIOLOGICAL EFFECTS OF AN ADDITIONAL STRESSOR ON FISH EXPOSED TO A SIMULATED HEAVY-METAL-CONTAINING EFFLUENT FROM A SULFIDE ORE SMELTERY,
National Swedish Environment Protection Board, Nykoeping.Brackish Water Toxicology Lab.
A. Larsson, C. Haux, M-L. Sjobeck, and G. Lithner.
Ecotoxicology and Environmental Safety, Vol. 8, No. 2, p 118-128, April, 1984. 5 Tab, 26 Ref.

Descriptors: *Physiological effects, *Perch, *Heavy metals, *Sulfide ore smelter, Industrial wastes, Water pollution effects, Anemia, Hypocalcemia, Hyperglycemia, Toxicity, Skelleftea Bay, Sweden, Simulation analysis.

Perches (Perca fluviatilis), kept in slightly hypotonic brackish water, were exposed to dilutions of a simulated heavy-metal-containing effluent from a sulfide ore smeltery. Biochemical and hematological effects of the effluent, as well as the metal residues in liver and muscle tissues, were investigated after 12 and 27 days of exposure. The metal analyses revealed no significant uptake of metals in liver and muscle during the experiment. In spite of this, the exposed fish showed several physiological effects. Some of these, e.g., anemia, hypocalcemia, increased muscle water content, and reduced liver size, were of a transient nature, while others, such as disturbed chloride balance and hyperglycemia, seemed to be more persistent. At the end of the experiment (29-33 days of exposure), the physiological response to stress treatment (asphyxia) and a subsequent recovery were studied in exposed and unexposed fish. This stress investigation indicates that an additional stressor may strengthen the toxic effects of the heavy-metal-containing effluent. Furthermore, the secondary stress responses were more pronounced and the ability to recover from them seemed to be impaired in exposed fish as compared to unexposed fish. (Author's abstract)
W84-04636

COMPARISON OF SEASONAL AND DIURNAL PATTERNS OF SOME PHYSICO-CHEMICAL PARAMETERS OF THE OPEN AND CLOSED PARTS OF LOKTAK LAKE, MANIPUR, INDIA,
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
D. K. Banerjee, B. Bhatia, and I. Haq.
International Journal of Environmental Studies, Vol. 21, No. 3-4, p 243-250, October, 1983. 9 Fig, 1 Tab, 25 Ref.

Descriptors: *Physicochemical properties, *Loktak Lake, *Manipur, *India, Seasonal variation, Diurnal distribution, Water pollution effects, Dissolved oxygen, Acidity.

A comparative study of the periodic and aperiodic variations of some physico-chemical parameters of the open and closed parts of the Loktak Lake, Manipur, India, was carried out for a 3 year period from 1976-78 to investigate possible effects of human activities on these variations. In both the open as well as the closed lake the pH displayed a clear seasonal variation, with the highest values in winter and the lowest values during the post monsoon period. In the open lake the seasonal variations of DO were similar to those of pH, with high values during winter and low in the post-monsoon period. In the closed lake there was no pattern of seasonal change in the DO. Post-monsoon peaks of chloride values for the year 1976 and 1978 were clearly seen in the open and closed lakes. Distinct diurnal patterns were discernible,

both in the closed and open lakes. The diurnal pattern of free carbon dioxide in the bottom samples from the closed lake were characterized by lower values in the day and higher values in the night. The bottom samples in the closed lake were different from the surface samples of the closed lake and from the surface and bottom samples of the open lake in that there were consistent diurnal patterns and relationships between the pH, free carbon dioxide, carbonate ions, calcium ions, and other parameters. These observations suggest that deviations from the normal expected diurnal variation pattern of simple physico-chemical parameters and of the relationship between these may possibly serve as a useful criterion of the degree of perturbation to which a lake is subjected due to human or natural causes. A direct instead of an inverse relationship between the diurnal variation of carbon dioxdide and pH in the open lake, the mechanism of which remains unexplained, may also have some significance in indicating unstable conditions in the lake. (Baker-IVI)
W84-04658

BIOLOGICAL EFFECT OF SOME POISONS ON CANTHOCAMPTUS (CRUSTACEA SPP),
All-India Inst. of Hygiene and Public Health, Calcutta. Dept. of Sanitary Engineering.
S. V. Rama Rao, and K. J. Nath.
International Journal of Environmental Studies, Vol. 21, No. 3-4, p 271-275, October, 1983. 5 Tab, 9 Ref.

Descriptors: *Biological effects, *Poisons, *Canthocamptus, Crustacea, Water quality standards, Toxicity, Ecological effects, Bioaccumulation, Water pollution effects.

Water quality standards are generally based on the effect of a single toxicant; unfortunately, the additive effects of a mixture of toxicants are never taken into account when implementing water quality standards. This paper evaluates the additive effect of a mixture of toxicants on Canthocamptus (Crustacea spp). The results suggest that the toxicity of certain toxicants like phenol is increased when the poison is present in combination with heavy metals or other poisons. The results of this study point to the need for greater care when fixing up the permissible level of the toxicants; in all cases, the relevant agencies should take into consideration the additive effect of a mixture of toxicants. (Murphy-IVI)
W84-04659

THE EFFECT OF CHRONIC OIL POLLUTION ON SALT-MARSH NITROGEN FIXATION (ACETYLENE REDUCTION),
William and Mary Coll., Gloucester Point, VA. Inst. of Marine Science.
For primary bibliographic entry see Field 2L.
W84-04669

EFFECTS OF DREDGING AND OPEN-WATER DISPOSAL ON BENTHIC MACROINVERTEBRATES IN A SOUTH CAROLINA ESTUARY,
South Carolina Wildlife and Marine Resources Dept., Charleston. Marine Resources Research Inst.
R. F. Van Dolah, D. R. Calder, and D. M. Knott.
Estuaries, Vol. 7, No. 1, p 28-37, March, 1984. 2 Fig, 2 Tab, 14 Ref. Army Corps of Engineers contract DACW60-77-C-0013.

Descriptors: *Environmental effects, *Ecological effects, *Open-water disposal, *Benthic macroinvertebrates, *South Carolina, *Estuaries, *Dredging, Sediments, Ocean dumping.

Approximately 28,475 cu m of muddy sediments were dredged from a shoal in a South Carolina estuarine system and released near the surface at a nearby site having high tidal current velocities. Effects at the dredged sites included decreased macrofaunal abundance and changes in species composition. These effects appeared to be short term, which substantial recovery occurring within 3 months. Rapid recovery was primarily attributed to immigration through slumping of channel wall sediments similar to those dredged. Detrimental effects on benthic macrofauna in the area of open water disposal were minimal. Most differences noted in community structure between collection dates were attributed to sampling and seasonal variability. The absence of a major longterm disruption to the benthos in the disposal area was probably due to (1) strong tidal currents, which rapidly dispersed the moderate amount of mud sediments released; (2) surface disposal, permitting wider dispersal; and (3) disposal during late autumn, a period of low faunal recruitment. (Author's abstract)
W84-04670

EFFECT OF POLLUTION ON PHYTOPLANKTON IN THE ASHAR CANAL, A HIGHLY POLLUTED CANAL OF THE SHATT AL-ARAB ESTUARY AT BASRAH, IRAQ,
Alexandria Univ. (Egypt). Dept. of Oceanography.
M. A. H. Saad, and S. E. Antoine.
Hydrobiologia, Vol. 99, No. 3, p 189-196, March, 1983. 2 Fig, 2 Tab, 34 Ref.

Descriptors: *Estuaries, *Water pollution effects, *Phytoplankton, *Ashar Canal, *Shatt al-Arab estuary, *Basrah, *Iraq, Wastewater disposal, Chemical properties, Species composition, Pollution load.

The effect of pollution on the phytoplankton in the Ashar Canal was studied during March and June 1976. Higher temperatures were recorded in June. The canal water was more turbid than that of the adjoining Shatt al-Arab estuary due to high algal populations and sewage disposal. The chlorosity values were remarkably high in the canal, due to sewage disposal. The flood waters in June lowered the chlorosity in both estuary and canal. Sewage disposal into the canal decreased its dissolved oxygen content. The lower oxygen values in the estuary in June were accompanied with higher temperatures. The pH values were generally higher in the estuary and were also higher in June than in March. Eighty-six algal taxa were recorded, 45 of which were diatoms. The phytoplankton in the estuary was more abundant in March, due to the increase in currents and turbidity in June. The Chlorophyta, Conjugatophyta, Myxophyta and Bacillariophyta in the estuary showed reverse seasonal trends from those of the total phytoplankton. These algae seemed to flourish during periods of high temperatures. The dense blue-green algae recorded in June is attributed to the high temperature and dissolved organic matter. The Chyrosphyta recorded high populations in the estuary in March and were totally absent in June. Lower temperatures and high transparency in March might have led to their relative abundance. The total phytoplankton in the Ashar Canal followed two different seasonal trends, one resembling and the other differing from those in the estuary. The disposal of domestic sewage and agricultural wastes in the canal seemed to lead to such adverse seasonal variations. The diatoms only dominated the phytoplankton at one station in both months. The sewage and agricultural wastes disposal seemed to favor the abundance of the other phyla than the diatoms. Increased organic load in the canal has led to a considerable increase in the Myxophyta in June. Blooms of Chlamydomonas sp. and Euglena acus increased the phytoplankton densities in March at stations II and IV, respectively. Benthic or periphytic algae were found in the phytoplankton populations. Raised salinity seemed to restrict the distribution of the planktonic diatom Bacillaria paradoxa. Among the noticeable widespread planktonic algae in the study area are Dinobryon sertularia, Pediastrum duplex and P. simplex. (Author's abstract)
W84-04680

BACTERIOPLANKTON IN THE ACIDIFIED LAKE GARDSJON,
Swedish Water and Air Pollution Research Lab., Goeteborg.
I. B. Andersson.
Hydrobiologia, Vol. 101, No. 1/2, p 59-64, April, 1983. 5 Fig, 1 Tab, 24 Ref.

Descriptors: *Bacterioplankton, *Acidic lakes, *Gardsjon Lake, Forest hydrology, Biomass, Hydrogen ion concentration, Bacteria, Chemical properties.

Total bacterial numbers in different strata of lake water and in inlet and outlet streams have been recorded during a yearly cycle. A calculated mean cell volume of 0.342 sq micro m has then been used to estimate bacterial biomass in the lake. Change of biomass during the year was substantial and the range was from about 0.1 g/cu m to about 1.0-1.2 g/cu m. The seasonal development included a spring-early summer increase followed by a decrease to the minimum in July-August. Correlation between epi- and hypolimnion was high and in both strata two dominant autumn peaks in biomass appeared. With the exception of the last autumn peak the development of bacterial biomass was closely related to development of phytoplankton biomass and production. (Author's abstract)
W84-04701

EFFECTS OF CHANGES IN DISCHARGE LEVEL ON TEMPERATURE AND OXYGEN REGIMES IN A NEW RESERVOIR AND DOWNSTREAM,
Guelph Univ. (Ontario). School of Engineering.
For primary bibliographic entry see Field 6G.
W84-04710

NUTRIENT AND OXYGEN REDISTRIBUTION DURING DESTRATIFICATION IN THE ELEFSIS BAY, AN ANOXIC BASIN,
Institute of Oceanographic and Fisheries Research, Athens (Greece).
For primary bibliographic entry see Field 2H.
W84-04713

INVERTEBRATES AND URBAN RUNOFF IN A SMALL NORTHERN STREAM, EDMONTON, ALBERTA, CANADA,
Alberta Univ., Edmonton. Dept. of Zoology.
E. R. Whiting, and H. F. Clifford.
Hydrobiologia, Vol. 102, No. 1, p 73-80, May, 1983. 8 Fig, 2 Tab, 25 Ref.

Descriptors: *Invertebrates, *Urban runoff, *Edmonton, *Alberta, *Canada, Environmental effects, chemical properties, Species diversity, Bioindicators.

The invertebrate fauna of a small northern stream was examined within Edmonton, Alberta. Many invertebrates that were common upstream of the city were absent or rare within the city. In contrast, some tubificids and chironomids were very abundant within the city. Diversity and richness (number of taxa) of the fauna were much lower within Edmonton than upstream, while the total density was much higher within the city. These changes in the urban invertebrate fauna were apparently caused by the discharge of organic materials and silt from storm sewer runoff. Chemical analysis of routinely-collected water samples did not show significant differences between urban and non-urban sites. This was probably due to the sporadic nature of storm sewer runoff. Peak levels of contaminants in the stream were usually missed because of the routine nature of sampling. Aquatic invertebrates, which exhibit long-term responses to sporadic runoff incidents, provided a better indication of stream water quality than did routine chemical monitoring. (Author's abstract)
W84-04716

EFFECT OF SOME SURFACE-ACTIVE ANIONIC AGENTS ON DAPHIA MAGNA STRAUS,
Akademiya Nauk URSR, Kiev. Inst. Biokhimii.
I. I. Lesyuk, N. I. Igumentseva, A. A. Lemishko, and S. I. Kusen.
Hydrobiological Journal, Vol. 19, No. 2, p 64-68, 1983. 4 Tab, 5 Ref.

Descriptors: *Surfactants, *Daphnia, Water pollution effects, Toxicity, Sodium sulfoethoxylate, Sodium olefinsulfonate, Sulfonates, Reproduction.

The survival and fecundity of Daphnia were studied in the presence of the anionic surfactants

sodium sulfoethoxyalate and sodium olefinsulfonate. Sodium sulfoethoxylate, with a C10 to C13 carbon chain, proved much more toxic than sodium olefinsulfonate with a C12 to C14 carbon chain. Their median lethal concentrations for the initial Daphnia population over 25 days of study are 78 and 126 mg/liter, respectively. The maximum tolerated concentrations are 27 and 79.8 mg/liter and absolute lethal concentrations are 129 and 177 mg/liter, respectively. Daphnia of the first and second generations are more sensitive to surfactants than in the initial generation. Daphnia fecundity is an inverse function of surfactant concentration. (Baker-IVI)
W84-04726

ZOOPLANKTON AND FEEDING OF YOUNG FISH IN THE ZONE OF DISCHARGE OF EFFLUENTS FROM THE TRIPOL'YE POWER PLANT,
Tikhookeanskii Nauchno-Issledovatel'skii Inst. Rybnogo Khozyaistava i Okeanografii, Vladivostok (USSR).
L. V. Voronchuk, O. I. Kudrinskaya, and S. F. Matchinskaya.
Hydrobiologia, Vol. 19, No. 3, p 35-40, 1983. 4 Fig, 2 Tab, 6 Ref.

Descriptors: *Zooplankton, *Feeding rates, *Fish, *Tripol'ye powerplant, *Discharge measurement, Thermal pollution, Water pollution effects, Fish behavior, Cladoceran, Rotifers, Fish food organisms, Fish diets, Biomass.

The zooplankton, the zoophytes and the feeding patterns of the fry of the most abundant fish species of the Kanev Reservoir during the summers of 1976 and 1977 were studied. The studies were conducted at Tripol'ye, near the point of warm water discharge from the power plant and at Khodorov, 50 km downstreams. The biomass and numbers of zooplankton in these areas were similar, with an average of 0.57 mg/liter and 62 individuals/liter, respectively. The smallest biomass was observed at Khodorov in 1977. The species composition of zooplankton was, however, different: cladoceran species were abundant in the Tripol'ye area, whereas at Khodorov a predominance of rotifers, small cladocerans and larvae of Dreissena were found. The fingerlings at Tripol'ye were better provided with food because of a better food base. (Murphy-IVI)
W84-04731

ORGANIC AND CHLORIDE POLLUTION IN LAKE NAINI TAL (INDIA),
Kumaun Univ., Naini Tal (India).
S. N. Das, and R. S. Bora.
Hydrobiological Journal, Vol. 19, No. 3, p 46-49, 1983. 1 Tab, 16 Ref.

Descriptors: *Lake Naini Tal, *India, *Organic compounds, *Chloride, Water pollution effects, Seasonal variation, Dissolved solids, Oxygen, Municipal wastewater, Dissolved oxygen, Detergents.

Seasonal dynamics and distribution of different organic matter fractions (dissolved, suspended and settled) were studied in the highland lake Naini Tal, India. Intense contamination of this lake has been caused by municipal wastes, which leads to organic matter accumulation and low oxygen content of the water. The silt covers the lake bottom with a layer 10 to 15 cm thick, high in organics whose decomposition liberates large volumes of ammonia and hydrogen sulfide. The chloride concentration varied from 26.0 mg/l in July to 34.0 mg/l in September. Chloride did not fluctuate so strongly as dissolved organic matter, settled organic matter or suspended organic matter, indicating that the chloride pollution is more or less constant throughout the year, whereas the input of organic pollutants varied significantly. Strong pollution with fecal matter, detergents and domestic drainage water was noted in the Talli Tal, as this area receives sewage from the many hotels in the city as well as houses and the Ramsay Hospital. The oxygen content correlated strongly with the settled and dissolved organic matter concentrations rather than with the suspended organic matter. (Baker-IVI)
W84-04732

POLLUTANT EFFECTS ON THE MIXED FUNCTION OXYGENASE (MFO) AND REPRODUCTIVE SYSTEMS OF THE MARINE POLYCHAETE NEREIS VIRENS,
Delaware Univ., Newark. School of Life and Health Sciences.
C. R. Fries, and R. F. Lee.
Marine Biology, Vol. 79, No. 2, p 187-193, 1984. 5 Fig, 1 Tab, 45 Ref. NSF grants OCE-8017893 and OCE-8016644.

Descriptors: *Water pollution effects, *Mixed function oxygenase, *Reproductive systems, *Polychaetes, *Nereis virens, Cytochrome P-450, Polychlorinated biphenyls, Oil pollution, Marine environment.

The cytochrome P-450 dependent mixed-function oxygenase (MFO) system of Nereis virens, found in the endoplasmic reticulum of the intestinal epithelium, has similar components and cofactor requirements when compared to other invertebrates. Worms exposed to food containing benzo(a)pyrene or a mixture of polychlorinated biphenyls (Aroclor 1254) had significantly higher MFO activity and cytochrome P-450 content than unexposed ones. N. virens from a site in Portland, Maine, USA, which was heavily contaminated with oil, and nearby 'clean' reference sites were studied. The weight, MFO activity and presence or absence of gametes were determined. The MFO activity in worms from the oil-contaminated site was approximately six times that of worms from the reference sites; worms from the reference areas were six times larger than oil-contaminated worms. Worms from the oil-contaminated area lacked or had undeveloped gametes in spring, summer and fall. In contrast, many of the worms collected from the reference sites at the same times had fully developed gametes. (Author's abstract)
W84-04737

COPPER SPECIATION IN SOFT, ACID, HUMIC WATERS: EFFECTS ON COPPER BIOACCUMULATION BY AND TOXICITY TO SIMOCEPHALUS SERRULATUS (DAPHNIDAE),
Michigan State Univ., East Lansing.
J. P. Giesy, A. Newell, and G. J. Leversee.
The Science of the Total Environment, Vol. 28, p 23-36, June, 1983. 2 Fig, 9 Tab, 52 Ref. DOE contract DE-AC09-76SR00819.

Descriptors: *Copper, *Chemical speciation, *Bioaccumulation, Chelation, Simocephalus, Toxicity, Organic matter, Well water, Pond water, Simulation, Mathematical models.

Comparative studies were conducted using water from a shallow pond and from a deep artesian well which is the primary water source for the pond. These waters are of very similar water quality, except for higher concentrations of dissolved organic carbon in the pond. The stoichiometry and affinity (conditional stability constants) of Cu chelation by naturally-occurring organic ligands were determined by numerical solutions of Scatchard relationships. These values were then used in the geochemical speciation model, GEOCHEM, to determine the relative importance of each Cu species in dynamic equilibrium with competing metals and ligands. The accumulation of Cu by and toxicity of Cu to the soft water cladoceran Simocephalus serrulatus (Daphnidae) were measured and related to Cu speciation. When 10 micro g Cu/L were added to pond water in the fall, the distribution of Cu was: Cu(++), 36.0%; Cu-organic, 63%; CuOH(-), 0.5% and CuSO4, 0.5%. The organics in pond water reduced Cu accumulation and toxicity. When the 24 h-LC50 values were reported as Cu(++), this species of copper was more toxic in pond water than well water. The toxicity of Cu may not be directly proportional to Cu accumulation by microcrustaceans. (Moore-IVI)
W84-04738

SUBLETHAL RESPONSES OF MYTILUS EDULIS TO INCREASED DISSOLVED COPPER,
Lawrence Livermore National Lab., CA.
F. L. Harrison, J. R. Lam, and R. Berger.
The Science of the Total Environment, Vol. 28, p 141-158, June, 1983. 5 Fig, 7 Tab, 37 Ref. DOE contract W-7405-ENG-48.

Descriptors: *Mytilus, *Copper, *Toxicity, Lysosomal enzymes, Protein binding, Bioindicators, Heavy metals, Water pollution effects, Enzymes, Mortality.

The mussel Mytilus edulis, because of its worldwide distribution, is used extensively as an indicator of metals. Two processes important in metal metabolism in mussels are the binding of metals to low molecular weight proteins which have some properties similar to those of metallothioneins and the incorporation of metals into membrane-bound vesicles which are similar in appearance to some lysosomes. Changes in the composition of copper-binding proteins and in the latency of lysosomal enzymes were detected in digestive gland cells of Mytilus edulis exposed to metals. Chronic exposure to copper resulted in concentrations of copper in low-molecular weight metallothionein-like proteins that were dependent on exposure concentration and time, and in a dose-dependent reduction in the latency of lysosomal hexosaminidase activity. A direct relationship between the copper concentration associated with the high molecular weight proteins and the mortality of mussels was observed. Mussels can detoxify elevated concentrations of soluble copper in the water, but the ability of the organisms to tolerate the copper is related to the exposure concentration and duration. (Moore-IVI)
W84-04745

THE EFFECTS OF DREDGING ON SEDIMENTS, PLANKTON AND FISH IN THE VAUVERT AREA OF LAKE ST. JEAN, QUEBEC (EFFET DU DRAGAGE SUR LES SEDIMENTS, LE PLANCTON ET LES POISSONS, DANS LA REGION DE VAUVERT AU LAC ST-JEAN, QUEBEC),
Quebec Univ., Chicoutimi. Dept. des Sciences Fondamentales.
L.-M. Lalancette.
Archive fur Hydrobiologie, Vol. 99, No. 4, p 463-477, 1984. 4 Fig, 5 Tab, 21 Ref.

Descriptors: *Dredging, *Lake St. Jean, *Quebec, *Sediments, Plankton, Fish, Environmental effects, Turbidity, Water pollution effects, Suspended particulates.

In 1977, the electrolysis and chemical company, Alcan, began dragging the shoreline of the Vauvert area of Lake St. Jean with a view to its restoration. Later in 1977 and in 1978, experiments were conducted to determine the impact of the dredging on sediments, plankton and fish. It was discovered that after dredging sediments lose their cohesion and its fine particles are dispersed by the currents; it also appeared that the nature of the dispersed sediment in the form of particles facilitated their return to the lake by the medium of wind, rain and waves. It was found that during dredging operations, because of turbidity, plankton decreases but then grows back very quickly when dragging is ended. The effects of the dragging were therefore of short duration. Finally, the results of the dragging operations relating to fish were inconclusive; however, a turbidity such as that at Vauvert, created in a laboratory, irritates the gills of fish and after some weeks the gills and the fish lose all their color. In the long run the turbidity kills the fish. (Author's abstract)
W84-04754

THE EFFECTS OF RAPID TEMPERATURE DECREASES BY FIVE FRESHWATER FISH SPECIES,
West Virginia Dept. of Natural Resources, Elkins. Div. of Wildlife Resources.
D. A. Cincotta, J. R. Stauffer, Jr, and C. H. Hocutt.
Archiv fur Hydrobiologie, Vol. 99, No. 4, p 529-536, March, 1984. 1 Tab, 37 Ref.

Group 5C—Effects Of Pollution

Descriptors: *Temperature effects, *Fish, Mortality, Cold shock, Cold resistance, Water temperature, Shiner, Dace, Pumpkinseed, Bass.

Instantaneous cold shock experiments were conducted on five species of freshwater fish acclimated to two temperatures between 24 and 36 degrees C. Golden shiner fish acclimated to 30 and 35 degrees C exhibited over 50% mortality when exposed to 12 degrees C. Satinfin shiner, when acclimated to 24 and 30 degrees C, found cold shock temperatures of 6 and 12 degrees C lethal, respectively. Blacknose dace, when acclimated to 24 and 28 degrees C, found lethal cold shock temperatures to be 6 degrees C. Pumpkinseed, when acclimated to 30 and 36 degrees C, found temperatures at which 50% or more mortality occurred in 10,000 min to be 12 and 18 degrees C, respectively. Largemouth bass specimens acclimated to 30 and 36 degrees C exhibited over 50% mortality when exposed to 12 degrees C. (Baker-IV)
W84-04757

NANOPLANKTON: CHIEF PRIMARY PRODUCERS IN LAKE NAINITAL,
Kumaun Univ., Naini Tal (India). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W84-04758

ALGAL BLOOM OF THE FLAGELLATE SYNURA UNVELLA IN THE KLINGENBERG AND LEHNMUHLE DRINKING WATER RESERVOIRS - ITS EFFECTS ON THE DRINKING WATER SUPPLY AND ITS TREATMENT (DIE MASSENENTWICKLUNG DER GEIBELALGE SYNURA UVELLA IN DEN TRINKWASSERTALSPERREN KLINGENBERG UND LEHNMUHLE - IHRE AUSWIRKUNGEN AUF DIE TRINKWASSERVERSORGUNG UND IHRE BEKAMPFUNG),
Wasserwirtschaftsdirektion Obere Elbe-Neibe (German, D.R.).
For primary bibliographic entry see Field 5F.
W84-04791

5D. Waste Treatment Processes

DESILTING OF INTAKE AND OUTLET WORKS OF THE BLAYAIS PLANT (CONCEPTION, REALISATION ET DEVASAGE DES OUVRAGES DE PRISE ET DE REJET D'EAU DE REFROIDISSMENT DE LA CENTRALE DU BLAYAIS),
Electricite de France, Paris. Region d'Equipement
J. Laurent, M. Davesne, F. Lemelle, and J. Ricco.
La Houille Blanche, No. 3/4, p 281-290, 1983. 10 Fig, 15 Ref.

Descriptors: *Desilting, *Intake gates, *Outlets, *Blayais Dam, Hydraulic design, Sedimentation, Mudflows, Mud, Spillways, Gironde estuary.

The Blayais plant on the Gironde estuary comprises four 900 MW units. The coolant water systems have been designed for optimum dilution of heat and to minimize recirculation effects while reducing the hydraulic and sedimentary impact on the estuary. Mud had clogged 4/5 th of the diameter of this 2200 m long piping following the successive immersion of 20 meter long sections in water with a high suspended sediment content, and E.D.F. had to deal with the problem of clearing it out. To avoid all risk of clogging on entry into service, the mud was eroded via an increase in the flow achieved by modulating the number of pumps in operation in relation to the working pressure of tides, and changes in the cross-section secured by a temporary cofferdam downstream of a provisional spillway installed for the purpose of discharging the excess mud. (Author's abstract)
W84-04225

MICROBIAL ATTACHMENT PROPERTIES IN EXPANDED-BED, ACTIVATED CARBON ANAEROBIC FILTERS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
Y. T. Wang, M. T. Suidan, and B. E. Rittman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-159730, Price codes: AO4 in paper copy, AO1 in microfiche. Water Resources Center Research Report No. 181, October, 1983. 52 p, 9 Fig, 6 Tab, 69 Ref. Project No. OWRT A-111-ILL (1), Contract/Grant No. 14-34-0001-2115.

Descriptors: Acetate, *Anaerobic filter, *Activated carbon, Expanded bed, Methanogenesis, Kinetics, Organic carbon, *Wastewater treatment, Model studies, Steady state biofilm kinetic model.

A completely mixed, expanded-bed, anaerobic granular activated carbon filter was operated on synthetic wastewaters in which acetate was the only organic carbon source. Steady-state performance was achieved for two influent acetate concentrations: namely, 800- and 1,600 mg/l. Steady-state removal efficiencies in chemical oxygen demand, dissolved ogranic carbon, and acetate exceeding 96, 97, and 98 percent were obtained, respectively. A steady-state biofilm kinetic model was employed for analyzing the two sets of 'steady-state' data. The modeling effort was successful in describing trends and effects; however, insufficient data were available to properly calibrate the model and obtain reliable values for the parametric constants.
W84-04228

PREDICTIVE MODELS FOR ACTIVATED SLUDGE TREATMENT OF TOXIC INDUSTRIAL WASTE COMPONENTS,
Delaware Univ., Newark. Dept. of Civil Engineering.
A. F. Gaudy, Jr., A. F. Rozich, and P. C. D'Adamo.
Availble from the National Technical Information Service, Springfield, VA 22161 as PB84-159722, Price codes: A02 in paper copy, A01 in microfiche. Delaware Water Resources Center Completion Report, November, 1982. 15 p, 2 Tab, 12 Ref. Project No. OWRT A-051-DEL (1), Contract/Grant No. 14-34-0001-2108.

Descriptors: *Activated sludge treatment, *Industrial wastes, *Biological treatment, *Phenols, *Wastewater treatment, Design, Operation, Performance.

Controversy exits regarding the most applicable modeling practice for design and operation of activated sludge processes treating waste containing significant portions of toxic organic compounds. The project research was undertaken to determine whether a non-inhibitory function (e.g., the Monod relationship) or one of several inhibitory functions (e.g., the Haldane equation) could more aptly describe the relationship between specific growth rate and substrate concentration. Phenol was employed as the potentially toxic carbon source in both bench-scale pilot plant studies and batch growth studies. In over 100 batch growth studies it was shown that, regardless of length of acclimation and source of microbial population, an inhibitor function was applicable. Of the five such functions tested for fit of the experimental data, the Haldane equation was selected as most representative and the most readily applicable to engineering calculations for predictive modeling of the performance of the continuous flow pilot plant. Both experimental results and analytical study of the design and operational equations led to the conclusion that the inhibitory function should be employed for treatment of phenolic waste. Values of the biokinetic constants were determined and a method for predicting critical growth rate (dilute-out) for the process was developed.
W84-04236

USE OF WATER HYACINTH AQUATIC TREATMENT SYSTEMS FOR AMMONIA CONTROL AND EFFLUENT POLISHING,
Roseville Public Works Dept., CA.
J. R. Hauser.
Journal of the Water Pollution Control Federation, Vol. 56, No. 3, p 219-225, March, 1984. 2 Fig, 3 Tab, 4 Ref.

Descriptors: *Wastewater treatment, *Plant populations, Water hyacinth, Turbidity, Chlorination, Harvesting, Suspended solids, Aeration, Ponds, Mosquitos, Biochemical oxygen demand, Ammonia.

The results of a 2 year pilot program investigating the use of water hyacinth aquatic treatment systems for ammonia removal and effluent polishing at a 0.52 cu m/s wastewater treatment plant in Roseville, California are presented. During the warm season, the test systems reduced ammonia by more than 70% in nonaerated ponds and 99% in a pond with supplemental aeration. Total nitrogen reductions in the warm seasen were approximately 55 and 70% for the nonaerated ponds and the aerated pond, respectively. Routine harvesting was not required to ensure good treatment performance. Harvesting did not improve overall ammonia or total nitrogen reductions in the warm season and led to lesser reductions in the cold season. Effluent BOD-5 and suspended solids levels were typically well below 10 mg/L. Winter die-back of hyacinths led to excessive organic loading in the late winter and spring and caused production of sulfides and concomitant odors in unmanaged ponds. Ease of effluent disinfection by chlorination was greatly enhanced by aquatic treatment. A substantial increase in effluent turbidity and suspended solids occurred temporarily after harvesting. Mosquito development was adequately controlled by mosquito fish. (Baker-IVI)
W84-04323

NITROGEN REMOVAL FROM MUNICIPAL WASTEWATER BY A SINGLE SUBMERGED FILTER,
Kobe Univ. (Japan). Dept. of Civil Engineering.
Y. Iida, and A. Teranishi.
Journal of the Water Pollution Control Federation, Vol. 56, No. 3, p 251-258, March, 1984. 5 Fig, 5 Tab, 7 Ref.

Descriptors: *Municipal wastewater, *Wastewater treatment, *Denitrification, *Nitrogen removal, Nitrogen, Sludge, Filtration, Nitrification.

An attached, combined sludge system was evaluated for nitrogen removal. The system required internal carbon sources for denitrification. An attempt was made to achieve carbon oxidation, nitrification, and denitrification of municipal wastewater in a single submerged filter. The nitrogen removal efficiency was affected by the ratio of aeration on to aeration off in an intermittent aeration cycle, detention times, effluent recycle ratios, and wastewater temperature. In single pass studies, which were carried out at wastewater temperatures above 20 degress C, nitrogen removal of about 65% was achieved with an 11 hr detention time and a 2 hr on 2 hr off intermittent aeration cycle. Nitrogen removal of about 55% occurred when the detention time was shortened to 7 hr at a 2 hr on 2 hr off intermittent aeration cycle. Effluent recycling improved nitrogen removal. The advantages to the system included simplicity of installation and operation, absence of any sludge recycling, low sludge production, no supplemental chemical feed for denitrificaton and pH control, and reduction of aeration time. (Baker-IVI)
W84-04325

OBSERVATIONS ON THE USE OF IRON(III) COMPLEXING AGENTS TO FRACTIONATE THE TOTAL FILTERABLE IRON IN NATURAL WATER SAMPLES,
Freshwater Biological Association, Ambleside (England).
J. D. Box.
Water Research, Vol. 18, No., 4, p 397-402, 1984. 7 Fig, 35 Ref.

Descriptors: *Iron, *Filtration, *Natural waters, Complexometry, Fractioning, Chemical properties, Water analysis.

The analysis for iron in natural waters is complicated by the chemistry of iron in aqueous solution which has resulted in the use of a wide range of analytically defined categories. Analysis of filtered

natural water samples using Fe(II) complexing agents (bathophenanthrolinedisulfonic acid, 2,2'-dipyridyl, ferrozine, TPTZ) and acetic acid-sodium acetate buffer (pH 4.6) showed that the absorbance of the iron(III) complex increased with time both in the presence and the absence of a reducing agent (ascorbic acid, hydroxylammonium chloride). Exposure of the samples to 0.1 M H Cl (pH approximately 1.3) for 1 h prior to the addition of the complexing agents resulted in a stable iron concentration which was designated the acid-extractable fraction of the total filterable iron. The results have implications for the complexometric determination of iron fractions other than total iron after acid digestion. (Murphy-IVI)
W84-04349

PENTACHLOROPHENOL BIOGRADATION-II; ANAEROBIC,
Purdue Univ., Lafayette, IN. Environmental Engineering Lab.
M. A. Guthrie, E. J. Kirsch, R. F. Wukasch, and C. P. L. Grady, Jr.
Water Research, Vol. 18, No. 4, p 451-461, 1984. 7 Fig, 2 Tab, 18 Ref.

Descriptors: *Biological wastewater treatment, *Biodegradation, *Anaerobic digestion, *Pentachlorophenol, Pesticides, Methanogenesis, Sludge digestion, Bacteria.

The fate of pentachlorophenol (PCP) during anaerobic digestion of sewage sludge solids was tested in a three phase protocol. Phase I involved acclimation: Phase II investigated biodegradation in semicontinuous-flow, stirred-tank reactors at solids retention times of 10, 20, and 40 days; phase III assessed the importance of nonbiological removal mechanisms and collected additional data concerning the extent of biodegradation. PCP was found to inhibit methanogenesis in unacclimated cultures at concentrations in excess of 200 microg/l and thus acclimation of the digesters to PCP required very gradual increases in the influent concentration thereby allowing enrichment of organisms capable of degrading PCP. Once acclimation was achieved, digestors receiving influent containing 5.0 mg/l PCP achieved stable operation with effluent PCP concentrations below 5 microg/l at all retention times studied. Sorption was shown to be unimportant in PCP removal. Volatilization was considered to be unimportant based upon results obtained in forced aeration studies. This suggested that PCP was subject to at least primary biodegradation. Other evidence collected during the study indicated that more complete biodegradation probably was occurring. (Author's abstract)
W84-04352

PHOSPHORUS REMOVAL IN A SEWAGE TREATMENT PLANT AND PLANT BIOMASS IN AN EFFLUENT RECEIVING LOWLAND STREAM,
East Brabant Dept. of Technology, Boxtel (Netherlands).
F. A. Kouwe.
Hydrobiological Bulletin, Vol. 17, No. 2, p 143-156, December, 1983. 8 Fig, 10 Tab, 13 Ref.

Descriptors: *Aquatic weed control, *Wastewater treatment, *Phosphorus removal, *Beerze, *Netherlands, Macrophytes, Aquatic weeds, Biomass, Streams, Streamflow.

The possibility of controlling plant growth by lowering the phosphorus concentration of the stream water through phosphorus removal in a sewage treatment plant was investigated. Biomass development, the role of the sediment, the natural phosphate concentration of streams, the phosphorus, nitrogen and potassium content of plants were studied. Decreasing the phosphorus concentration in the lowland stream Beerze by means of P-reduction with ferrosulfate in the sewage treatment plant Hapert did not lead to a decrease in biomass of aquatic macrophytes in this stream. To achieve a substantial decrease in the production of plant biomass by lowering the P-concentration of the water more measures are needed than P-reduction in sewage treatment plants only. Measures should be taken to reduce or possibly even to eliminate the influence by agricultural activities and stormwater overflows as well as the removal of nutrient rich sediments. (Baker-IVI)
W84-04378

THE EFFECTS OF INCREASED SALINITY LEVELS ON THE REACTION OF BIOLOGICAL WASTEWATER TREATMENT,
Guam Univ., Agana. Water and Energy Research Inst. of the Western Pacific.
T. A. Dillaha, III, and W. J. Jolan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84163153, Price codes: A01 in paper copy, A01 in microfiche. Technical Report No. 37, July, 1983. 50 p, 3 Fig, 10 Tab, 27 Ref, 1 Append. OWRT A-028-GUAM (1), 14-34-0001-2112.

Descriptors: *Biological wastewater treatment, *Salinity, *Stabilization ponds, *Wastewater treatment, Aerobic conditions, Micronesia, Biochemical oxygen demand.

A series of eight 31 liter bench-scale aerobic waste stabilization ponds were operated for 73 days to assess the potential performance of waste stabilization ponds in Micronesia and to determine how elevated salinity levels affect pond kinetics. The outdoor reactors were loaded with screened raw domestic sewage and operated on a draw and fill basis. Salinity levels in the reactors varied from 600 to 36,000 mg/l with detention times ranging from 6.2 to 15.5 days. The mean influent values for biochemical oxygen demand, BOD5 and suspended solids, SS, were 86.7 and 61.9 mg/l, respectively. The mean effluent values for the last 20 days of the experiment ranged from 2.3 to 11.2 mg/l BOD5 and from 3.8 to 44.3 mg/l SS. Reactor 1, which contained no supplemental salt, consistently had the highest treatment efficiency. All of the reactors met the EPA secondary treatment standard of less than 30 mg/l BOD5 but all the saline reactors had SS concentrations in excess of 30 mg/l. Effluent SS concentrations were high in the saline reactors and very low in the freshwater reactor. The results of this study show that waste stabilization ponds are an extremely viable waste treatment option in Micronesia.
W84-04404

WATER RECYCLE IN THE ORGANIC CHEMICAL AND PLASTIC MATERIALS INDUSTRIES,
Centec Corp., Reston, VA.
For primary bibliographic entry see Field 3E.
W84-04406

WASTE-MANAGEMENT INFORMATION FOR DECISION MAKING,
Michigan State Univ., East Lansing. Dept. of Agricultural Engineering.
D. R. Heldman.
Food Technology, Vol. 37, No. 12, p 41-43, December, 1983. 2 Fig, 11 Ref.

Descriptors: *Food-processing wastes, *Decision making, Planning, Wastewater treatment, Food processing industry, Model studies.

The food processing industry contributed significantly to the loads in waste streams leading to the waterways as a result of the large quantities of waste material generated during most types of food processing and the biological activity associated with these materials. At least two feasible approaches to waste management include the reduction of food product solids entering the waste streams, and the conversion of waste materials into usable by-products. Efficient management requires detailed information on the raw product entering the processing operation. The influence of each of the processing steps will have a definite effect on the product and on the amount and types of waste streams generated. Some of the most valuable information comes from the direct analysis of waste streams. However, such analysis does not usually provide insight into the sources of the various components. To illustrate the use of processing-waste information in decision making, two models for processing-waste reduction are compared. The first model is for monitoring product losses associated with a series of individual processing stages, and the second is for determining the feasibiliy of introducing a by-product recovery facility into a waste stream before the final waste-treatment stage. Use of both models would lead to the maximum potential for waste-treatment reduction. The first model provides assurance that the maximum amounts of raw product are converted into primary product and are not entering the food processing waste stream. The second model provides assurance that the minimum quantities of the the primary waste stream are allowed to reach the waste-treatment system. (Baker-IVI)
W84-04422

A NOTE ON FLUORIDE REMOVAL BY REVERSE OSMOSIS,
State Univ. of New York at Buffalo. Dept. of Chemical Engineering.
B. R. Min, A. L. Gill, and W. N. Gill.
Desalination, Vol. 49, No. 1, p 89-93, January, 1984. 1 Fig, 13 Ref. NIH Grant 150-HO81L.

Descriptors: *Reverse osmosis, *Fluoride, *Wastewater treatment, Membrane processes, Industrial wastes.

Various types of fluoride are discharged by steel, aluminum, glass, phosphate, electroplating, welding, and ceramic industries. There is increasing interest in the use of reverse osmosis for wastewater treatment because it is simple and there is no lower limit to the fluoride concentration of the permeate which may be obtained. Reverse osmosis membrane transport data for sodium fluoride solutions are correlated by a linear plot of 1/ the reject coefficient versus 1/the total volume flux. The slope of the plot is independent of feed concentration over a 5-fold range from about 360 to 1800 ppm. The reject coefficient at infinite volume flux is slightly less than unity. (Baker-IVI)
W84-04556

WATER QUALITY IMPACTS OF BIOCHEMICAL OXYGEN DEMAND UNDER TRANSFERABLE DISCHARGE PERMIT PROGRAMS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
E. D. Brill, Jr., J. W. Eheart, S. R. Kshirsagar, and B. J. Lence.
Water Resources Research, Vol. 20, No. 4, p 445-455, April, 1984. 11 Tab, 16 Ref.

Descriptors: *Water quality, *Biochemical oxygen demand, *Transferable discharge permits, Water quality management, Cost analysis, Dissolved oxygen, Water quality control, Willamette River, Delaware River estuary.

Biochemical oxygen demand is an important example of water pollutants that degrade biochemically and affect water quality according to the location as well as the strength of the discharge. Therefore, it is important to examine carefully the potential water quality impacts of a program of transferable discharge permits (TDP's) to regulate these discharges prior to the implementation of such a program. This paper provides a framework for evaluating these impacts and illustrates trade-offs among cost efficiency, equity, and uncertainty with respect to meeting water quality goals. Examples are given for the Delaware River estuary and the Willamette River. Violations of the standard could occur under a TDP program. Restrictions on the market could be used, however, to control or possibly to eliminate such violations. Limits on the total discharge in sections of the basin, zone boundaries for markets, and revaluation factors for transferred permits were effective individually or in various combinations. Even with these restrictions, however, there is sufficient flexibility so that significantly more cost-efficient solutions are obtained than under direct regulation programs that treat all discharges uniformly. (Murphy-IVI)
W84-04568

CONTROLLING DISCHARGES OF WATER PLANT WASTES TO THE OHIO RIVER,

Ohio River Valley Water Sanitation Commission, Cincinnati.
A. H. Vicory, and L. Weaver.
American Water Works Association Journal, Vol. 76, No. 4, April, 1984. 3 Fig, 1 Tab.

Descriptors: *Water pollution control, *Wastewater management, *Ohio River, Wastewater disposal, Sedimentation, Coagulation, Filtration, Pollution load.

The question of regulating discharges of water plant wastes to the Ohio River was recently addressed by the Ohio River Valley Water Sanitation Commission. A study undertaken in 1981 indicated that effluents from the drinking water treatment plant processes of sedimentation, coagulation, and filtration contributed little or no additional loading to the river. Across-the-board, technology-based requirements for removing waste solids prior to discharge were therefore deemed inappropriate because of the cost of such systems with no benefit to the receiving waters. The policy adopted allows controlled release of such discharges on a case-by-case basis, provided that no adverse effects on designated stream uses will result. (Author's abstract)
W84-04579

BIOLOGICALLY INDUCED VARIATIONS IN THE NATURE AND REMOVABILITY OF THM PRECURSORS BY ALUM TREATMENT,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
R. C. Hoehn, K. L. Dixon, J. K. Malone, J. T. Novak, and C. W. Randall.
American Water Works Association Journal, Vol. 76, No. 4, April, 1984. 16 Fig, 4 Tab, 18 Ref. OWRT project A-087-VA.

Descriptors: *Alum treatment, *Biological properties, *Trihalomethanes, Algae, Heterotrophic organisms, Fate of pollutants, Dissolved solids, Claytor Lake.

A study was conducted to examine whether biological activity in a reservoir, which is partly responsible for seasonal variations in finished water trihalomethane (THM) concentrations, could affect the efficiency of alum coagulation in removing THM precursors. Alum coagulation reduced THM precursors by about 50 percent, and its effectiveness did not appear to be altered by variations in algal or bacterial population densities in the lake. Alum coagulation reduced THM precursors by about 50%, and its effectiveness did not appear to be altered by variations in algal or bacterial population densities. The yields of THMs from the remaining DOC, however, were generally greater when biological activity in the reservoir was high. Diurnal variations in the levels of high-THM-yielding precursors, caused by intense biological activity, could affect the ability of a water treatment plant to produce water with THM levels consistently less than the maximum contaminant level of 0.10 mg/L. (Murphy-IVI)
W84-04582

THE COAGULATION OF HUMIC SUBSTANCES BY MEANS OF ALUMINUM SALTS,
Missouri Univ.-Rolla. Dept. of Civil Engineering.
B. A. Dempsey, R. M. Ganho, and C. R. O'Melia.
American Water Works Association Journal, Vol. 76, No. 1, p 141-150, April, 1984. 11 Fig, 3 Tab, 76 Ref. EPA grant R808104.

Descriptors: *Coagulation, *Humic Substances, *Aluminum salts, Aluminum, Hydrogen ion concentration, Organic carbon, Polyaluminum chloride, Wastewater treatment, Performance evaluation.

Mechanisms for the removal of humic substances from water by coagulation with aluminum salts were studied by means of conventional jar test procedures. The type of aluminum coagulant has a very strong effect on conditions (pH and log Al sub T) under which removal of FA will occur, as well as on the extent of FA removal. Removal of humic substances was determined by measuring total organic carbon or by direct ultraviolet spectroscopy. Use of alum appears to be preferable within the sweep floc pH zone, whereas the PACl that was used in these experiments is a better coagulant at all pH values more acidic and at some pH values more basic than the alum sweep floc zone. At pH < 5, removal may occur by the direct precipitation of FA by monomeric species of aluminum. Between pHs 5 and 6 the predominating reaction depends on the applied dosage of aluminum; at low dosage the FA will be precipitated by polymers of aluminum. At pH > 7, removal of FA occurs by adsorption of FA or soluble FA-aluminum complex on a precipitate of Al(OH)3(s). These generalizations are based on indirect evidence, including the effects of sulfate, type of FA, and concentration of FA on FA removal. The type of fulvic acid has a strong impact on the zones where removal of FA occurs. Strong FA-aluminum complexation hinders the removal of FA when precipitation of Al(OH)3(s) or formation of polymers of aluminum is necessary for removal (pH > 5); strong FA-aluminum complexation enhances the removal when direct precipitation of FA by monomeric aluminum can occur (pH < 5). The choice of coagulant for the removal of FA will depend on the FA type and concentration, pH and pH buffering, certain other components of the water, the volume of sludge that is generated, and the availability and cost of the coagulants. Polyaluminum chloride, an unconventional coagulant in the United States, is a promising alternative to alum for removing humic substances from some water supplies. (Murphy-IVI)
W84-04583

THE REMOVAL OF ORGANIC HALIDE PRECURSORS BY PREOZONATION AND ALUM COAGULATION,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
D. A. Reckhow, and P. C. Singer.
American Water Works Association Journal, Vol. 76, No. 4, p 151-157, April, 1984. 21 Fig, 1 Tab, 33 Ref. EPA grant R-810235.

Descriptors: *Organic halides, *Preozonation, *Alum coagulation, Wastewater treatment, Ozonation, Alum, Coagulation, Organic compound, Organic carbon, Trihalomethane, Comparison studies, Chlorination, Ultraviolet radiation.

An increased awareness of potentially carcinogenic micropollutants in US drinking waters has led to a reevaluation of several well-established treatment techniques. The major focus of this concern has been on the recently recognized hazards of chlorination - the formation of both trihalomethanes and total organic halides. Coagulation has also been the subject of renewed investigation because of its ability to remove halogenated organic precursors. Trichloroacetic acid, dichloroacetic acid, dichloroacetonitrile, and 1,1,1-trichloroacetone were formed during the pH 7 chlorination of all aquatic humic materials tested. Chloroform comprised approximately 20% of the TOX, whereas trichloroacetic acid and dichloroacetic acid accounted for about 18 and 6%, respectively. Alum coagulation removed all precursors tested (THM, TOX, TCAA, DCAA, DCAN, and 1,1,1-trichloroacetone) to a significant extent. The percentage removals showed the same trends as, but were not identical to, the percentage removals for TOC and UV absorbance. In contrast to coagulation, UV absorbance was destroyed to a far greater extent during preozonation than the THM, TOX, or trichloroacetic acid precursors. Similarly, TOC was removed by ozonation to a much lesser extent than the THM, TOX, or trichloroacetic acid precursors. Ozonation at 0.3 and 1.2 mg O3/mg C, at natural bicarbonate levels and pH 7, hindered the alum coagulation of organic precursors and the coagulation of TOC and UV-absorbing substances. This diminished overall removal as a result of preozonation was seen both with an aquatic fulvic acid solution and a moderately colored raw drinking water. (Murphy-IVI)
W84-04584

BIOLOGICAL ACTIVATED CARBON-AT WHAT COST,
Philadelphia Water Dept., PA.
H. M. Neukrug, M. G. Smith, S. W. Maloney, and I. H. Suffet.
American Water Works Association Journal, Vol. 76, No. 4, p 158-167, April, 1984. 15 Fig, 16 Tab, 33 Ref.

Descriptors: *Biological activated carbon, *Activated carbon, Oxidation, Ozonation, Wastewater treatment, Cost analysis, Cost-benefit analysis, Water treatment facilities, Delaware River, Philadelphia, Pennsylvania.

The combination of oxidation by ozonation and adsorption by granular activated carbon is commonly referred to as the biological activated carbon process. Used as a basis for this evaluation are the operating conditions and results of a three-year, pilot-scale investigation of advanced water treatment systems that was conducted on Delaware River water in Philadelphia, PA. Ozonation prior to GAC treatment decreases organic loads applied to the GAC bed, increases organic biodegradability, and provides for viral and bacterial disinfection without producing chlorinated by products. On the other hand, the potential exists for the production of oxidation by-products with unknown effects on health and for a decrease in GAC service life for removal of volatile halogenated organics. Further, although volatilization significantly reduces the concentrations of volatile organics, it merely converts a water pollution problem into an air pollution problem. The cost of preozonation is not sufficiently offset by lower GAC operating costs when removal of volatile halogenated organic compounds is the criterion controlling GAC service life. For TOC reductions, preozonation is a cost-effective measure, but other, more conventional, treatment options may offer equal system performance at lower total costs. For odor control, both GAC and ozone-GAC consistently performed well. Again, however, the absence of any improvement with preozonation makes its use uneconomical for taste and odor reductions. For Philadelphia's consumers a conversion to install GAC or ozone-GAC options would increase (depending on the criterion chosen) from 14 to 24% the price of water for all consumers. Although these increases at first appear reasonable, the estimates are for the Torresdale plant only. Conversion of all three plants could cost an additional 75 to 100% of the estimates shown. Since the costs to the consumer would be substantial, the water utility must appraise the consumer's readiness to spend additonal dollars for GAC or ozone-GAC treatment. (Murphy-IVI)
W84-04585

PREVENTING HALOFORM FORMATION IN TREATED SURFACE WATER: A CASE STUDY,
Technion - Israel Inst. of Tech., Haifa.
Y. Argaman, S. E. Shelby, Jr., J. S. Davis, S. C. Betts, and R. J. Hufft, Jr.
American Water Works Association Journal, Vol. 76, No. 4, p 172-176, April, 1984. 7 Tab, 8 Ref.

Descriptors: *Water pollution prevention, *Haloforms, *Treated water, Trihalomethanes, Chloramine, Comparison studies, Disinfection, Ozonation, Granular activated carbon, Pilot plants, Water treatment facilities.

In the United States, the EPA has established a maximum contaminant level (MCL) of 0.10 mg/L for total trihalomethanes in finished drinking water. The growing concern over this contaminant is a result of evidence that some trace organics have carcinogenic and mutagenic properties. Treatment of a surface water was investigated in bench-scale and pilot-plant tests that consisted of flocculation, settling, filtration, granular activated carbon (GAC) treatment, and ozonation. Either GAC treatment or ozonation was necessary to meet the color limit of 15 Co-Pt units. Disinfection with a free chlorine residual without formation of high trihalomethane (THM) levels could only be achieved on GAC-treated effluent. Application of chlorine dioxide resulted in very low THM levels. The required dosage, however, was high unless preceded by GAC treatment. Chloramine could be used as a disinfectant with any of the treatment

schemes without resulting in THMs or other known public health problems. (Murphy-IVI)
W84-04587

SIMPLIFIED MODELS FOR DESIGN OF FIXED-BED ADSORPTION SYSTEMS,
Michigan Technological Univ., Houghton. Water and Waste Management Programs.
D. W. Hand, J. C. Crittenden, and W. E. Thacker.
Journal of Environmental Engineering, Vol. 110, No. 2, p 440-456, April, 1984. 3 Fig, 2 Tab, 33 Ref. NSF grant CME 79-24589.

Descriptors: *Model studies, *Design criteria, *Fixed-bed, *Adsorption, Homogeneous surface diffusion model, Organic compounds, Water quality, Water quality control, Mathematical models.

Fixed-bed adsorber dynamics have been predicted successfully using the homogenous surface diffusion model (HSDM) for over 100 adsorbate-adsorbent systems which include a number of the possibly harmful organics that may be found in drinking water and wastewater. Solutions to the HSDM for fixed-bed adsorber systems have been developed and can be used to: (1) Plan the scope of pilot-scale studies by identifying least-cost fixed-bed adsorber operations; (2) interpret pilot-scale test results; and (3) design full-scale adsorbers if the HSDM can simulate pilot-scale data. To facilitate the use of these solutions, the important model parameters and their effect on adsorber performance has been discussed; additionally, a detailed procedure for determining the effluent concentration history profile has been presented. Techniques to calculate the empty bed contact time of the mass transfer zone and the liquid-and solid-phase concentrations within the fixed bed have also been provided. (Author's abstract)
W84-04599

SURFACE TENSION OF POLLUTED WATERS AND TREATED WASTEWATER,
Ibadan Univ. (Nigeria). Dept. of Preventive and Social Medicine.
M. K. C. Sridhar, and C. R. Reddy.
Environmental Pollution (Series B), Vol. 7, No. 1, p 49-69, 1984. 4 Fig, 10 Tab, 14 Ref.

Descriptors: *Surface tension, *Polluted water, *Treated water, *Wastewater, Wastewater analysis, Water properties, Physical properties, Physical analysis, Water analysis.

A comprehensive study was made on the measurement of surface tension of natural waters, artificially polluted waters, domestic wastewater and effluents obtained by treating wastewater by different physical, chemical and biological methods. There was a significant negative correlation between the surface tension and the oxidizable organic matter (3 min PV) and a significant positive correlation between dissolved oxygen content and the surface tension. Oils and detergents reduced the surface tension of water to the minimum level. The biological treatment improved surface tension values to such an extent that the final quality resembled pure water. The vorticellid group of protozoa played an important role in the increase of surface tension of wastewater. (Author's abstract)
W84-04625

BORON CONTROL IN POWER PLANT RECLAIMED WATER FOR POTABLE REUSE,
Raymond Kaiser Engineers, Inc., Oakland, CA.
J. M. Wong.
Environmental Progress, Vol. 3, No. 1, p 5-11, February, 1984. 2 Fig, 5 Tab, 30 Ref.

Descriptors: *Reclaimed water, *Boron, Water reuse, Water treatment, Wastewater treatment, Drinking water, Public health, Ion exchange resins, Reverse osmosis.

An engineering study was conducted on boron control in reclaimed water for potable reuse. The scope of the study included literature research on health effects of boron in drinking water and its effect on sanitary wastewater treatment systems. In addition, an evaluation was made of the potential boron-removal processes, including pilot-column ion-exchange resin testing. It included cost estimates and selection of the most desirable boron-removal process for the potable system. On the basis of test data, strong-base anion exchange is recommended as a boron-control process for the treatment of evaporator effluent. (Baker-IVI)
W84-04628

RECYCLING INDUSTRIAL WASTES BY LAND APPLICATION,
Anheuser-Busch Companies, Inc., Bakersfield, CA. Environmental Engineering and Resources.
L. W. Keith, and D. L. Stack.
Environmental Progress, Vol. 3, No. 1, p 53-56, February, 1984. 1 Fig, 4 Tab.

Descriptors: *Land disposal, *Wastewater disposal, *Food-processing wastes, Industrial wastes, Bakersfield, California, Wastewater irrigation.

Land application of compatible industrial effluents is a cost-effective and environmentally acceptable method of achieving resource conservation and recycling. A yeast plant began an evaluation of land application in 1975 in Bakersfield, CA in order to relieve the loading on that city's wastewater treatment plant of a high-strength by-product stream from the yeast facility. The primary objectives of their various land application projects include: allowing timely production facility expansion; alleviate overloading problems of existing mechanical wastewater treatment systems; reduce overall wastewater-disposal costs; reduce energy consumption compared to conventional wastewater-treatment and commercial fertilizer production; recycle of nutrients and water from the production process; and provide an aesthetically appealing wastewater treatment system with the elimination of discharge of effluents to surface waters. The company has proven that full-scale land-application of high-strength wastewaters can be done successfully. A land-application system is complex and requires detailed design and extensive operational management. The combination of land application and intensive agricultural activities results in the degree of site management required for successful effluent utilization. The necessity for site preparation required to assure proper drainage cannot be overemphasized. Land application, when properly designed and operated, does meet its primary objective of recycling nutrients and water to the end in an energy-efficient and cost-effective manner. (Baker-IVI)
W84-04629

REMOVAL OF PHENOL USING WATER HYACINTH IN A CONTINUOUS UNIT,
Excel Industries Ltd., Bombay (India).
S. Vaidyanathan, K. M. Kavadia, M. G. Rao, S. Basu, and S. P. Mahajan.
International Journal of Environmental Studies, Vol. 21, No. 2, p 183-191, August, 1983. 3 Fig, 3 Tab, 17 Ref.

Descriptors: *Biological wastewater treatment, *Hyacinth, *Phenols, Economic factors, Industrial wastes, Organic compounds, Wastewater treatment.

In an attempt to apply water hyacinth as a low cost treatment system for phenol, experimental runs on a continuous unit were performed. Phenol in concentrations of 25 mg/l, 100 mg/l, and 125 mg/l was added to the overhead tank, hyacinth and control tank. Nutrients were added. Detention times of 24 hours and 36 hours were kept and flow rate adjusted. For a particular retention time and flow rate, the effluent concentration from the overflow pipe was analyzed in triplicate for phenol. After the effluent concentration corresponding to the influent concentration had acquired a stable value, the contents of the tank were drained and influent concentrations were changed. This procedure was repeated for different flow rates and concentrations. The removal efficiency was correlated with influencing parameters such as organic loading and hydraulic loading. The correlation offered a simple tool for the optimal design of a water hyacinth system for phenol on an industrial scale. (Baker-IVI)
W84-04656

GROWTH STUDIES OF AZOLLA PINNATA RBR. IN A PERMANENT POND,
Indian Inst. of Tech., New Delhi. Centre for Rural Development and Appropriate Technology.
T. S. Kumar, P. Vasudevan, and S. V. Patwardhan.
International Journal of Environmental Studies, Vol. 21, No. 3-4, p 296-300, 1983. 1 Fig, 1 Tab, 7 Ref.

Descriptors: *Biological wastewater treatment, *Azolla, *Spirodela, Water hyacinth, Aquatic plants, Aquatic weeds, Biomass,.

The growth pattern of Azolla pinnata in association with Spirodela polyrhiza was studied in a permanent pond. These two plants would provide a regular source of biomass. The suitability of integration of Azolla pinnata into other aquatic plant-based wastewater treatment systems has been proposed. Azolla pinnata offers favorable qualities as a component in wastewater treatment systems. An Azolla-water hyacinth system is also supported by the findings reported. In fact, Azolla may be preferred over duck weed in waste water systems along with water hyacinth, as the interspace between water hyacinth plants may offer a favorable micro-environment for Azolla's growth in the form of protection from direct sunlight in summer months due to the canopy of water hyacinths. This association may lead to a continuous culture of Azolla rather than periods of isolation in summer. (Baker-IVI)
W84-04660

SIGNIFICANCE AND BEHAVIOUR OF HEAVY METALS IN WASTE WATER TREATMENT PROCESSES; I. SEWAGE TREATMENT AND EFFLUENT DISCHARGE,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
J. N. Lester.
The Science of the Total Environment, Vol. 30, p 1-44, September, 1983. 8 Tab, 190 Ref.

Descriptors: *Heavy metals, *Wastewater treatment, Literature reviews, Biological wastewater treatment, Primary wastewater treatment, Sedimentation, Flocculation, Settling, Microorganisms, Bacteria, Toxicity, Effluents, Water pollution effects, Water reuse.

The literature concerning the significance and behavior of heavy metals in waste waters is reviewed. Factors influencing the partition of heavy metals between the solid and liquid phases in both primary and secondary (biological) treatment are considered in detail. It is evident that during primary treatment only metals present in an insoluble form will be removed, but the removal of such forms is strongly influenced by the factors controlling sedimentation. During secondary treatment metals initially present as soluble forms may be removed by association with the settleable biomass; further removal of insoluble metals also occurs by association with this biomass. Efficient flocculation and settling is critical to the removal of all metal forms during secondary treatment. Extracellular material, principally bacterial extracellular polymers, but also proteins and nucleic acids released as the result of cell lysis, appear to play a very significant role in the removal of soluble metals during secondary treatment. If biological treatment plants are overloaded with metals, toxic effects on bacteria and other microorganisms may result in poor quality effluents; although the micro-organisms responsible for waste water treatment are able, within limits, to acclimatize to elevated metal concentrations. The impact of heavy metal contaminated effluents on receiving waters has also been reviewed and it is concluded that the most serious problem posed is drinking water production in areas where water reuse is practiced. (Author's abstract)
W84-04747

SIGNIFICANCE AND BEHAVIOUR OF HEAVY METALS IN WASTE WATER TREATMENT PROCESSES; II. SLUDGE TREATMENT AND DISPOSAL,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
J. N. Lester, R. M. Sterritt, and P. W. W. Kirk.
The Science of the Total Environment, Vol. 30, p 45-83, September, 1983. 2 Fig, 16 Tab, 156 Ref.

Descriptors: *Sludge disposal, *Sludge treatment, *Heavy metals, Literature reviews, Anaerobic digestion, Land disposal, Toxicity, Chemical speciation, Bioavailability, Groundwater pollution, Marine pollution, Legislation, Standards.

The literature concerning the significance and behavior of heavy metals in sewage sludge treatment and following sludge disposal is reviewed. Particular attention is given to metal form during anaerobic digestion and following sludge disposal to agricultural land and to sea, and the influence of metal form on toxicity. It is evident that anaerobic digestion results in a strong association between sludge particulates and heavy metals due to the formation of inorganic precipitates, organo-metallic interactions and by association with the biomass. Toxic inhibition of anaerobic digestion by metals is concluded to be a direct result of the free metal ion concentration and thus mechanisms designed to reduce metal toxicity are based on artificial modification of heavy metal speciation in the digester. Guidelines and legislation designed to limit the application of sludge to agricultural land and the disposal of sludge to sea are reviewed and discussed. Following the application of sludge to agricultural land significant changes occur in heavy metal speciation, which ultimately determine metal availability to plants and potential contamination of groundwaters. Guidelines for application to land currently take limited account of metal form, although the importance of metal speciation is being recognized. Sludge disposal to sea has received relatively little attention with efforts being directed towards monitoring rather than more fundamental research. However, it is apparent that significant heavy metal solubilization may occur following sludge discharge to the marine environment. It is concluded that sludge disposal to agricultural land and sea, which are increasingly becoming subject to more stringent international pressures, should take account of the ultimate forms of heavy metals in the receiving environment and that a more unified approach should be adopted in the formulation of standards for all forms of sludge disposal. (Author's abstract)
W84-04748

RESULTS AND GOALS OF THE SAALE-WERRA WATER MANAGEMENT AREA IN RATIONAL WATER USE (ERGEBNISSE UND AUFGABEN DER WASSERWIRTSCHAFTS-DIREKTION SAALE-WERRA BEI DER RATIONELLEN WASSERVERWENDUNG),
Wasserwirtschaftsdirektion Saale-Werra, Halle (German D.R.).
For primary bibliographic entry see Field 3E.
W84-04779

INFORMATION AND RECOMMENDATIONS ON TOPICAL QUESTIONS CONCERNING WATER CONSERVATION BY MEANS OF SOIL TREATMENT WITH WASTEWATER (INFORMATIONEN UND EMPFEHLUNGEN ZU AKTUELLEN FRAGEN DES GEWASSERSCHUTZES DURCH ABWASSERBODENBEHANDLUNG),
D. Kramer.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 4, p 120-121, April, 1983.

Descriptors: *Conferences, *Water conservation, *Wastewater irrigation, *Sludge disposal, Land disposal, Water pollution control, Advanced wastewater treatment, Nutrients, Water reuse, Fertilizers, Wastewater disposal.

The proceedings and conclusions of a conference on 'Effective Water Conservation By Means of Soil Treatment with Wastewater (WST) and Sewage Sludge Utilization in Crop Production' held in the German Democratic Republic are reported. WST has the potential of reducing pollution in surface waters, allowing utilization of secondary raw materials in the form of nutrients, and contributing considerably to rational water use by substituting wastewater for treated water in agricultural irrigation. Subjects of conference presentations included organizational problems in ensuring regular use of increasing amounts of wastewater and in guaranteeing operation during the winter, the meaning of WST as an advanced wastewater treatment method (especially for nutrient elimination), level of purification reached on agricultural land used by WST facilities for overflow (for average loads of 3,200 mm/yr a 4-yr period: 5-day BOD = 85-95%, phosphorus and nitrogen degradation of 99.5% and 58%, respectively), the influence of sprinkling with municipal wastewater on the yield of various fruits and on macro- and micronutrient concentrations in soil, and the type of WST facility to be used. Discussions on sewage sludge utilization included production and technological problems, the influence of sludge containing heavy metals on crop yield, and sludge use in manufacturing organic fertilizer. As a result of the conference proceedings, the following recommendations concerning future activities were made: regulations on the organization of WST facilities including progressive processes for wastewater treatment outside the growing season; establishment of scientific, technological, and economic data for WST control; capture of return flow from wastewater irrigation and its reuse for irrigation; studies in the influence of heavy metals in WST and sewage-sludge utilization; and utilization of sewage sludge in the national program for the increase of soil fertility. (Gish-IVI)
W84-04788

LYSIMETER STUDIES TO MEASURE WASTEWATER PURIFICATION LEVEL AND NUTRIENT CONCENTRATION IN PERCOLATED WATER (LYSIMETERUNTERSUCHUNGEN ZUR ABWASSERREINIGUNG UND NAHRSTOFFKONZENTRATION IM SICKERWASSER),
Forschungszentrum fuer Bodenfruchtbarkeit Muencheberg(German, D.R.).
For primary bibliographic entry see Field 3C.
W84-04792

5E. Ultimate Disposal Of Wastes

HYDROGEOLOGIC INVESTIGATION OF THE MAXEY FLATS RADIOACTIVE WASTE BURIAL SITE, FLEMING COUNTY, KENTUCKY,
Geological Survey, Louisville, KY. Water Resources Div.
For primary bibliographic entry see Field 5B.
W84-04244

SIMULATING THE HYDRAULIC BEHAVIOR OF A SEWAGE SLUDGE-AMENDED MINE SOIL,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2G.
W84-04464

GEOHYDROLOGY OF INDUSTRIAL WASTE DISPOSAL SITE,
United States Ecology, Inc., Louisville, KY.
R. K. Ganor.
Journal of Energy Engineering, Vol. 11, No. 1, p 10-21, March, 1984. 6 Fig, 2 Tab, 5 Ref.

Descriptors: *Industrial wastes, *Waste disposal, *Deserts, *Nevada, *Geohydrology, Groundwater barriers, Radioactive wastes, Hazardous wastes.

An existing desert site for hazardous chemical and low-level radioactive waste disposal is evaluated for suitability as an industrial waste disposal site. The site is characterized using geologic, geohydrologic, geochemical, and other considerations. Design and operation of the facility is considered. The site is located in the Amargosa Desert, which is a northwesterly trending valley between Bare Mountain and the Amargosa Mountain Range. The area consists of broad, flat valleys separated by rugged mountain ranges. The valley floor is formed of unconsolidated deposits of gravel, sand, silt, and clay derived from weathering of the mountains. The valley basement is assumed to be similar to the Paleozoic sedimentary and metamorphic rocks with Tertiary igneous intrusions, primarily basaltic and rhyolitic lavas and rhyolitic tuffs similar to the rocks exposed on Bare Mountain to the north. Five deep borings and several shallower ones have been drilled to determine site characterization, monitoring, and regulatory requirements. The average annual precipitation at Lathrop Wells is 2.5 in; that for Beatty is about 4.5 in. Potential evapotranspiration at the site is about 36 in/yr. Regionally the major ground water units are present in the interstices of the unconsolidated deposits in the valley floor and the upgradient alluvial fans. The regional gradient is determined to be on the order of 30 ft/mile and the general direction of flow is along the trend of the valley with the major recharge being effected by surface runoff at the base of the confining ridges. Recharge from the Amargosa and its tributaries is considered negligible. (Baker-IVI)
W84-04492

SIGNIFICANCE AND BEHAVIOUR OF HEAVY METALS IN WASTE WATER TREATMENT PROCESSES; II. SLUDGE TREATMENT AND DISPOSAL,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
For primary bibliographic entry see Field 5D.
W84-04748

5F. Water Treatment and Quality Alteration

IS METROPOLITAN TORONTO'S DRINKING WATER SAFE,
F. J. Horgan.
Water and Pollution Control, Vol. 122, No. 1, p 19-21 and 36, January/February, 1984.

Descriptors: *Water quality control, *Drinking water, *Toronto, *Ontario, Water pollution control, Guidelines, Potable water, Trihalomethanes.

Concern has been voiced over the quality of drinking water in Toronto mainly because of the much publicized situation along the Niagara River where chemical wastes were deposited for years before their potential hazard was known. Tests made on the drinking water have indicated that the organic and inorganic content of the water is much below the levels specified in the guidelines as being safe. The ability of laboratories and the equipment now used to detect impurities in the drinking water down to the ppt level has increased our awareness of the presence of trace amounts of pollutants, thus adding to the concern of the general public, even though these contaminants were present before but simply undetectable. Some of the cost factors associated with quality control of drinking water are discussed. (Baker-IVI)
W84-04207

RENOVATION OF STEAM ELECTRIC POWER PLANT COOLING TOWER BLOWDOWN FOR NON-POTABLE REUSE,
Rexnord, Inc., Milwaukee, WI. EnviroEnergy Technology Center.
R. Osantowski, J. Kane, and A. Geinopolus.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-153550, Price codes: A09 in paper copy, A01 in microfiche. Report RU-83/8, January, 1984. U.S. Bureau of Reclamation, Washington, DC. 165 p, 23 Fig, 26 Tab, 13 Ref, 1 Append. Project No. OWRT C-10054-R (1478) (1), Contract/Grant No. 14-34-0001-1478.

Descriptors: *Reverse osmosis, *Demineralization, Industrial wastes, Pilot plants, *Electrodialysis,

Recycling, Filtration, *Water reuse, Cooling tower blowdown, Water treatment.

Findings are presented of a nine month pilot plant study investigating non-potable reuse potential of electric power plant cooling tower blowdown. The two demineralizing technologies studied included reverse osmosis and electrodialysis. Pretreatment throughout the testing was performed using chemical softening/clarification and dual media filtration. During the investigation, about 4,000 operating hours were put on each of the two desalting technology membranes to obtain information on membrane life expectancy. The most promising treatment technologies which meet the make-up water quality requirements for reuse of the cooling tower blowdown in the tower recirculating water system, as determined by pilot treatment train performance, as discussed. Potential power plant water reuse applications have been identified along with the water quality and quantity requirements. Comparisons were then made to the treated blowdown quality achieved from each of the pilot process elements.
W84-04237

NEW WATERWORKS FOR THE REDEVELOPMENT OF BAGHDAD CITY, WITH PARTICULAR REFERENCE TO THE LARGE DIAMETER TRANSMISSION PIPELINES,
W. J. Carlyle.
Journal of the Institution of Water Engineers and Scientists, Vol. 37, No. 5, p 385-400, October, 1984. 5 Fig, 2 Tab.

Descriptors: *Pipelines, *Water transport, *Baghdad, *Iraq, Water supply, Water supply development, Water demand, Tigris River, Euphrates River, Dokan Reservoir, Mosul Reservoir.

Oil wealth has triggered a major urban redevelopment in Baghdad, including a completely new water supply and drainage system. This will comprise about 9000 km of transmission and distirbution water mains, together with new intake works, treatment works, storage reservoirs and pumping stations, and 9000 km of sewers and associated pumping stations and sewage treatment plants. A major development program calls for regulation of the Tigris and Euphrates rivers from a combination of upstream storage reservoirs, some of which, such as the Dokan reservoir, already exist, and others, such as the Mosul reservoir on the main Tigris, are under construction. The major element which will allow for complete regulation of both rivers is the storage capacity which has been created in the Tharthar depression between the two rivers. In most cases the river water provides a satisfactory source of raw water, with relatively good bacteriological quality. The new plants under construction or proposed will deal with excessive turbidity by two stage settlement, with polyeletrolyte dosing in the presettlement tanks to reduce the overall suspended solids. (Baker-IVI)
W84-04308

MALMESBURY GROUNDWATER SCHEME,
Wessex Water Authority, Bristol (England).
C. J. Swinnerton, and M. A. Hillyer.
Journal of the Institution of Water Engineers and Scientists, Vol. 37, No. 5, p 421-436, October, 1983. 6 Fig, 3 Append.

Descriptors: *Groundwater management, *Water supply development, *Malmesbury, *England, Planning, Management, Water demand, Water supply, Environmental effects, Flow augmentation.

The groundwater scheme at Malmesbury is discussed from identification through investigation, development, promotion, and operation. To identify the optimum strategy for the development of new sources to meet the future deficiencies all possible resource options were compared by means of a resource allocation and costing computer system. In order to reach water demand projections by the year 2011, an additional 56 Ml/d is required. The area of investigation embraced the entire surface water and groundwater catchments upstream of Great Somerford, on the river Bristol Avon, lying mainly in Wiltshire but with parts in Avon and Gloucestershire. The surface catchment is some 260 sq km, but the groundwater catchment is some 95 sq km larger since the groundwater divide lies inside the Thames surface water catchment. Specific investigations were made concerning agricultural considerations, environmental considerations, water quality, pumping tests, and effects of groundwater abstraction. The scheme will provide on average an additional 18 Ml/d of water for potable supply by direct supply and, within the overall proposals, provision is made to discharge up to 26 Ml/d of stream support water during times of low flow. (Baker-IVI)
W84-04310

DESIGN, CONSTRUCTION AND OPERATION OF TULLICH WATER TREATMENT WORKS, USING OZONE TREATMENT,
Cuthbertson (Robert H.) and Partners, Edinburgh (Scotland).
I. A. T. Gowans, and C. J. McFadzean.
Journal of the Institution of Water Engineers and Scientists, Vol. 37, No. 5, p 437-459, October, 1983. 8 Fig, 5 Tab, 6 Ref.

Descriptors: *Water treatment, *Ozonation, *Scotland, *Color, Peat, Disinfection, Tullich water works, Water treatment facilities.

Experience with the treatment process at Tullich over the past four years has shown that ozone can successfully be used to treat Scottish peat stain waters with colors up to 60 degree H. Three minor improvements could be made: material selection of the diffuser end caps and tie rods; sealing of access manhole covers to the ozone contact chambers; and inspection portholes should have been placed in all of the ozone contact chambers to check visually the ozone distribution pattern. Operationally there are no problems associated with the production of ozone provided that a dew point of minus 50 degrees C is maintained in the supply air to an ozonizer. The application of ozone to the water is a simple process to control, with color being the only parameter which an operator is required to monitor. (Baker-IVI)
W84-04311

THE EXPLOITATION OF POLLUTED WATERS FOR POTABLE SUPPLIES,
Binnie and Partners, London (England).
A. L. Downing, and F. W. Crowley.
Journal of the Institution of Water Engineers and Scientists, Vol. 38, No. 1, p 39-57, February, 1984. 3 Fig, 11 Ref.

Descriptors: *Water treatment, *Drinking water, *Potable water, *Water supply development, Conservation, Sulfates, Chlorides, Hardness, Heavy metals, Dissolved organic matter, Cost analysis.

In many parts of the world keeping pace with rising demands for water often requires exploitation of sources of relatively poor quality. To decide the most cost-effective policy, options must be compared in quantitive terms. Some of the factors to be considered are: the means and costs of treating wastewaters and abstracted water to given standard; the effects of pollution on the quality of natural waters; and the relationship between the quality of raw and treated waters and their suitability for given uses. Information is given on water quality criteria and standards for potable supply; and current problems including non-biodegradable organic matter, algae, chlorides, sulfates, hardness and heavy metals. The treatability of polluted raw waters is described with examples offered of Bedok Catchment, Singapore; Lough Neagh, Northern Ireland; Camiri, Bolivia; and the Swan/Avon Tributaries in Perth, Australia. Cost information on the treatment of difficult waters as described is also considered. (Baker-IVI)
W84-04319

TREATMENT OF ARSENIC(V)-CONTAINING WATER BY THE ACTIVATED CARBON PROCESS,
Delaware Univ., Newark. Coll. of Urban Affairs and Public Policy.
C. P. Huang, and P. L. K. Fu.
Journal Water Pollution Control Federation, Vol. 56, No. 3, p 233-242, March, 1984. 16 Fig, 4 Tab, 45 Ref.

Descriptors: *Arsenic, *Activated carbon, *Water treatment, Adsorption, Acidity, Regeneration, Drinking water, Organic compounds.

Arsenic removal characteristics of some commercial activated carbons were investigated with emphasis on important parameters such as carbon type, pH, and total arsenic concentration. The regeneration of arsenic-laden activated carbon was also studied. Of the 15 different brands of commercial activated carbon tested, two, D-X and D-XI, seemed to be the most effective. Maximum As(V) removal occurred at pH 4 to 5. Electrostatic attraction and the formation of specific chemical bonds were the major adsorption mechanisms. This was evident from the reversal of surface charge on As(V) adsorption. Treatment with these activated carbons met drinking water standards. The presence of oganics such as Tiron had no effect on As(V) removal. The presence of Fe(II) drastically increased both the rate and the extent of As(V) removal. Treating As(V)-laden activated carbon with strong acid or base effectively stripped off adsorbed As(V) species. However, As(V) adsorption was not restored by strong acid or base treatment. The As(V) adsorption capacity of the strong acid or base treated activated carbon was greatly improved by further treatment with Fe(III) salts. (Baker-IVI)
W84-04324

OZONATION AND OXIDATION COMPETITION VALUES; RELATIONSHIP TO DISINFECTION AND MICROORGANISMS REGROWTH,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
K. Bancroft, P. Chrostowski, R. L. Wright, and I. H. Suffet.
Water Research, Vol. 18, No. 4, p 473-478, 1984. 6 Fig, 3 Tab, 24 Ref. EPA grant CR806256-02.

Descriptors: *Ozonation, *Oxidation, *Disinfection, *Delaware River, *Pennypack Creek, *Schuylkill River, *Wissahickon Creek, *Philadelphia, *Pennsylvania, Bacterial growth, Water treatment, Microorganisms, Organic carbon.

This study was conducted to determine the role of oxidation competition value (omega) in an ozone disinfection process and to evaluate the potential bacterial growth capacity of water as a result of ozonation. The omega value is a measure of the competition for ozone by a reference solution and the total organic matter present in the water sample. Water samples for this study were taken from various sites in the Philadelphia area including the Delaware River, Schuylkill River, Pennypack Creek and Wissahickon Creek. Ozonation was carried out using a Welsbach T408-ozonator. Good correlations were obtained between TOC, omega and three measures of microbial inactivation (90% kill, 50 degrees kill and breakpoint). The amount of ozone applied that was required to obtain each of the inactivation parameters was greater when the TOC and omega values of the water were higher. The amount of ozone required to obtain these parameters was independent of initial bacterial density. Initial death rates were related to the quantity of ozone applied. While ozonation may result in a reduction of TOC concentration, the results using Delaware River water indicated the capacity for potential regrowth of microorganisms may be enhanced. (Moore-IVI)
W84-04354

PARTICLE FORMATION AND GROWTH IN DILUTE ALUMINUM (III) SOLUTIONS; CHARACTERIZATION OF PARTICLE SIZE DISTRIBUTIONS AT PH 5.5,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
W. J. Snodgrass, M. M. Clark, and C. R. O'Melia.
Water Research, Vol. 18, No. 4, p 479-488, 1984. 8 Fig, 2 Tab, 13 Ref. EPA grant R-808104.

Descriptors: *Aluminum, *Water treatment, *Particle size, Fulvic acids, Humic substances, Color, Turbidity, Ionic strength, Hydrogen ion concentration.

Aluminum salts are widely used as coagulants in water treatment to remove turbidity and color. The removal of humic substances is currently receiving much attention because they have been identified as precursors for potential carcinogens formed by reactions with chlorine. The humic materials used in this research are fulvic acids, the predominant form of humics in surface waters. Particle formation and growth over the 1-40 micro m size range in dilute aluminum solutions (approx. 0.0002 M) was studied using an electronic particle counter. Sulfate, fulvate and hydroxide ion accelerate the rate of particle formation and changes of the particle size distribution over time. Increasing ionic strength (inert electrolyte) produces similar but less dramatic effects. Combinations of sulfate and fulvic acid or sulfate and inert electrocyle further accelerate the rate of particle formation. Aluminum chloride solutions at moderate ionic strength are devoid of supramicron particles after several days. A conceptual pathway model is developed which suggests that two different solids are formed when aluminum is added to fulvic acid solutions: an aluminum-fulvate precipitate and Al(OH)3(s). The first solid dominates in fulvic acid solutions at pH about 5.5. The model stresses the role of sulfate in aluminum polymer formation and in the formation of both solids. It views the role of pH as being an important controller of particle formation; the role of ionic strength is viewed as secondary in importance. (Moore-IVI)
W84-04355

DISSOLVED ORGANIC MATTER AND THE DISSIPATION OF CHLORINE IN ESTUARINE WATER AND SEAWATER,
Old Dominion Univ., Norfolk, VA. Dept. of Oceanography.
G. T. F. Wong, and T. J. Oatts.
Water Research, Vol. 18, No. 4, p 501-504, 1984. 3 Fig, 1 Tab, 18 Ref. DOE grant EE-77-S-05-5572.

Descriptors: *Chlorination, *Organic matter, *Estuarine water, *Seawater, *James River, *Virginia, *Chesapeake Bay, Molecular weight, Organic carbon, Chlorine demand.

Dissolved organic matter in estuarine water and seawater collected in the summers of 1980 and 1981 in the James River, Virginia and the mouth of Chesapeake Bay were separated into fractions according to their nominal molecular weights (NMW) by ultrafiltration. Estuarine waters contained higher concentrations of dissolved organic carbon (DOC). Among the fractions, between 66-89% of the DOC was found in the fraction with NMW below 10,000. Estuarine waters also had higher chlorine demands. At a dose of 5 mg/l, in 23 h, about 90% of the added chlorine disappeared in estuarine waters, whereas, in seawater, only 60-75% of the chlorine had dissipated. At least two-thirds of the chlorine demand occurred in the first 5 h. About 10-30% of the chlorine demand may be attributed to the fraction with NMW about 10,000. The remaining chlorine demand was distributed almost equally between the fractions with ranges of NMW of 1000-10,000 and below 1000. If reactivity is measured in terms of organic chlorine demand (delta Clo) per unit weight of DOC, the fractions with lower NMW (less than 1000 and 1000-10,000) always had a higher reactivity towards chlorine. Between these two fractions, the one with NMW between 1000 and 10,000 exhibited higher reactivity more frequently. The highest reactivity found was 1.4 mg delta Clo/mg DOC. (Author's abstract)
W84-04356

EXPERIENCE IN MONITORING DOMESTIC WATER SOURCES AND PROCESS WATERS FOR TRACE ORGANICS,
South Dakota School of Mines and Technology, Rapid City. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W84-04387

GEOLOGY AND THE WATER SUPPLY IN THE AREA OF THE FORMER DUCHY OF NASSAU (GEOLOGIE UND WASSERVERSORGUNG IM GEBIET DES FRUHEREN HERZOGTUMES NASSAU),
W. Stengel-Rutkowski.
Jahrbucher des Nassauishcen Vereins fur Naturkunde, Vol. 106, No. 1, p 14-26, 1983. 1 Fig, 1 Tab, 15 Ref.

Descriptors: *Water supply, *Water supply development, Reservoirs, Groundwater, History, Water resources development, West Germany.

The history of the development of a water supply network in the area previously known as the Duchy of Nassau, Federal Republic of Germany (FRG), is described in relation to its geology. The area is bordered on the west and south by the Rhine and Main rivers, respectively, and covers about 4,700 sq km. It consists largely of the East Rhine slate mountains, which are predominantly clayey and sandy slate with low permeability: despite high precipitation, the area has one of the smallest groundwater supplies in the FRG. Adequate supplies are present in the basalt Westerswald, the Limburg basin, and the lower Main plain. Before and during the time of the Duchy, rivers and streams were the main source of water, supplemented by shallow groundwater wells; only certain towns had water supply systems (e.g., provision of spring water to Weilburg via suspension bridge in 1784). The water supply only became a problem in the Prussian era with higher standards of hygiene and the industrial revolution. Central systems were constructed between 1890 and 1914; significant were the four Wiesbaden shafts for groundwater extraction from the Taunus range and the advent of water towers. All districts could be included only with the development of pump technology and energy networks. During the 1960's, well-drilling technology improved, and disused mine working became groundwater collectors as demand increased, while in the 70's, small districts began to form combined water organizations. Water importing grew in significance. Water quality standards also improved, resulting in increased treatment of groundwater whose quality had decreased with industrialization and its associated pollution. This led to the formation of water conservation areas. Since groundwater supplies are inadequate, the future must bring development of surface water resources, including dam construction in the Taunus to provide drinking water reservoirs. Water importing will remain significant. (Gish-IVI)
W84-04403

WATER MANAGEMENT,
P. Millington.
Process Engineering, Vol. 65, No. 3, p 55 and 57, March, 1984.

Descriptors: *Computers, *Automation, *Water supply, Water management, Planning, Training, England.

In order for automation to be successful in water management concerns, much education remains to be done for operators and managers of the automatic instrumentation. They must learn to accept the new disciplines and use the systems provided. At least 5 of the 10 United Kingdom water regions have introduced automation in one form or another and others are giving it careful thought. One recent installation within the Thames Water Authority is at the Deptford group of pumping stations. The group provides over 400,000 consumers with an average of 80 megaliters of water per day. The control center at Deptford has been equipped with a Microtel 700 microprocessor-based telemetry and telecontrol system. A network of outstations is linked to a Cromos central station. In Yorkshire water quality analytical instrumentation has been placed into the water authority's evaluation and demonstration facility. Whether automation of water management is to be successful in the long term depends not so much on the computer and the system as on the people operating it. Training is essential. (Baker-IVI)
W84-04413

APPROPRIATE MINERAL CONTENT OF DESALINATION WATER - THEORY AND DRINKERS' REACTION. PART I,
Italimpianti of Australia Pty Ltd., Sydney.
For primary bibliographic entry see Field 3A.
W84-04557

STUDIES ON HOME WATER TREATMENT SYSTEMS,
Environmental Protection Agency, Washington, DC.
F. A. Bell, Jr., D. L. Perry, J. K. Smith, and S. C. Lynch.
American Water Works Association Journal, Vol. 76, No. 4, p 126-130, April, 1984. 1 Fig, 7 Tab, 6 Ref.

Descriptors: *Drinking water, *Water treatment, Endotoxins, Efficiency, Trihalomethanes, Organic compounds, Water quality control, Organic compounds, Chlorinated hydrocarbons, Microorganisms, Groundwater, Surface water.

Commercially available home water treatment systems were tested to compare the efficiency of more than 30 units in removing volatile organic chemicals and to investigate the microbiological and endotoxin concentrations found in the filter effluents. Statistical information on every unit tested is presented in a series of tables. Units were of various types including faucet bypass, pour-through, stationary, and line bypass. Data is listed concerning trihalomethane and nonpurgeable total organic carbon reductions, average trihalomethane reduction efficiencies by type of commercial unit, statistical comparison of standard plate count and endotoxin data from test unit effluent and control loop samples - groundwater study, summary performance for halogenated organics removal during rated lifetime of units in the groundwater study, range of percentage reduction of specific halogenated organics (carbon tetrachloride, 1,1,1-trichloroethane, trichloroethylene, and tetrachloroethylene) in groundwater studies, and the range of percentage reduction of specific halogenated organics (p-dichlorobenzene, hexachlorobenzene, and chlordane) in a surface water study. (Baker-IVI)
W84-04580

BORON CONTROL IN POWER PLANT RECLAIMED WATER FOR POTABLE REUSE,
Raymond Kaiser Engineers, Inc., Oakland, CA.
For primary bibliographic entry see Field 5D.
W84-04628

EXACTING DEMANDS OF THE 1983 PEOPLE'S ECONOMIC PLAN ON WATER INDUSTRY PERSONNEL MUST BE FULFILLED WITH HONOR (HOHE ANFORDERUNGEN DES VOLKSWIRTSCHAFTSPLANES 1983 AND DIE WASSERWIRTSCHAFTLER IM KARL-MARX-JAHR EHRENVOLL ERFULLEN),
H. Reichelt.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 3, p 75-77, March, 1983.

Descriptors: *Water supply, *Utilities, *East Germany, Water law, Water demand, Water conservation, Water pollution control, Industrial water, Wastewater treatment, Water use.

Goals for the water industry in the German Democratic Republic for 1983 were set at the Fifth Conference of the Central Committee of the German Socialist Unity Party. The 1983 plan must be implemented in conjunction with the new water law of 7/2/1982. A stable water supply is the central aim, particularly as the long drought of 1982 left unfavorable conditions in many reservoirs and ground water supplies. Rational water used is the keystone of the plan; this consists mainly of elimination of wastage, reductions in water losses, in specific water requirement per product unit in industry, in water use in high-demand areas, and in pollution (through reclamation of valuable substances found in wastewater, increased effectiveness of existing wastewater treatment facilities, and the construction of new ones), decreased use of

drinking water for industrial purposes, and the diversion of drinking water from industrial waterworks into the public supply. The economic strategy required to put these measures into practice comprises higher productivity and a corresponding decrease in materials, energy use, and funding. Productivity must increase by 4.4% in the Water Supply and Wastewater Treatment (WSWT) division and by 3.8% in Water Management. Water demand must increase by no more than 0.8%, and specific industrial demand must decrease by at least 5%. WSWT is expected to save 14.8 million cu m/yr drinking water by reducing water loss, while industry and other high users should save 7 million cu m/yr. Work and living conditions for workers will continue to be improved: at least a further 1,200 jobs will be reorganized and manual labor will be reduced. (Gish-IVI)
W84-04778

MODEL STUDIES ON PREVENTIVE MEASURES AGAINST DAMAGE BY POLLUTANTS AT BANK FILTRATE INSTALLATIONS (MODELLUNTERSUCHUNGEN ZU VORBEUGENDEN MABNAHMAN GEGEN SCHADSTOFFHAVARIEN AN UFERFILTRATFASSUNGEN),
H. J. Diersch, and P. Nillert.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 3, p 103-107, March, 1983. 7 Fig, 1 Tab, 12 Ref.

Descriptors: *Filtration, *Water treatment, Water pollution effects, Mathematical models, Groundwater pollution, Groundwater recharge, Pollution load, Raw water.

Construction of bank filtrate installations as two parallel galleries along the bank rather than a single gallery results in several advantages: a balancing of sudden appearances of peak pollutant loads with undiminished conveyance capacity, further reduction of pollutant concentration by selective use of galleries, and prevention of forseeable pollution damage through individualized gallery design. Mathematical models were constructed to describe the flow and migration transport of matter processes in two-gallery installations of various dimensions. The processes are seen as a binary sys'em comprising two miscible chemical components: the dissolvable substance (pollutant) and the solvent (water) and are described by connected nonlinear differential equation systems. Variable parameters were distance between galleries (e), duration of pollutant inflow, and migration parameter of dispersion. Results showed that the two-gallery design reduced peak levels of pollutants, especially when separate utilization of raw water from well B in the gallery further from the bank occurred; that the optimal design (i.e., significant peak level reduction without significant increase of pollutant inflow duration) was with e = 50 m (also = distance between wells, which were placed alternately on each gallery), when a 50% peak level reduction with a 19% duration increase occurred at well B; and that this design makes possible a nonuniformly greater range of variation for the prevention of supercritical pollution loads in the raw water. However, the two-gallery systems has no effect on pollutants that can be accumulated by the end user regardless of their concentration, since it does not eliminate these, only reduces their concentration. The design can also be used for groundwater enrichment facilities and may be applied not only for new installations but also in the rebuilding of old ones. (Gish-IVI)
W84-04784

ALGAL BLOOM OF THE FLAGELLATE SYNURA UNVELLA IN THE KLINGENBERG AND LEHNMUHLE DRINKING WATER RESERVOIRS - ITS EFFECTS ON THE DRINKING WATER SUPPLY AND ITS TREATMENT (DIE MASSENENTWICKLUNG DER GEIBELALGE SYNURA UVELLA IN DEN TRINKWASSERTALSPERREN KLINGENBERG UND LEHNMUHLE - IHRE AUSWIRKUNGEN AUF DIE TRINKWASSERVERSORGUNG UND IHRE BEKAMPFUNG),
Wasserwirtschaftsdirektion Obere Elbe-Neibe (German, D.R.).
K. Putz, J. Benndorf, H. Glasebach, and G. Kummer.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 4, p 135-138, April, 1983. 4 Fig, 5 Ref.

Descriptors: *Drinking water, *Dresden, *Freital, *East Germany, *Eutrophication, Synura, Reservoirs, Solar radiation, Water treatment, Activated carbon, Aluminum sulfate, Calcium hydroxide, Hydrogen ion concentration, Nutrients, Water pollution control, Algae.

In Spring 1982 a strong fishy and oily odor and taste appeared in the drinking water in part of the city of Dresden and in Freital, German Democratic Republic. This was due to an unprecedented algal bloom of Synura uvella in the Klingenberg (K) and Lehnmuhle (L) reservoirs. The algae were able to develop because of high light levels in the reservoirs in February (21 sunny days, double the usual, and a snow-free ice cover) and insufficient circulation after the March thaw. At the Coschutz waterworks, 30 g/cu m activated carbon was added and aluminum sulfate was increased from 2 to 10 g/cu m. At the K waterworks, activated carbon could not be used for technological reasons; aluminum sulfate was also increased to 10 g/cu m to no effect. The entire catchment area is a water conservation area; official agencies were charged with reducing nutrient inflow into the reservoirs, particularly by banning wastewater from a dairy. At K, raw water was taken from a new level, but this was unsuccessful, as the mobile algae were found at all depths. At the time of the bloom, 50% of total phosphorus inflow at K came from L, so all inflow from L was stopped on 3/11/82. Application of 5 mg/l calcium hydroxide raised pH to 9-10 and eventually killed the algae in test samples; this dosage was begun at K on 4/3 and ended on 4/4. The peak effect was found on 4/7 when pH was 8.3-9.2 and almost all algae were dead. By 4/9 drinking water quality was restored. L served as a control to show that the demise of the algae was not due to chance. (Gish-IVI)
W84-04791

5G. Water Quality Control

USE OF LINERS FOR CONTAINMENT AT HAZARDOUS WASTE LANDFILLS,
EMCON Associates, San Jose, CA.
For primary bibliographic entry see Field 8G.
W84-04201

GROUNDWATER PLAN SIDESTEPS CONTAMINATION WOES,
Lexington-Fayette Urban County Government, KY.
S. M. Kilner.
Water Engineering and Management, Vol. 131, No. 3, p 27-29 and 32-34, March, 1984.

Descriptors: *Groundwater management, *Water pollution control, Aquifers, Management, Water management, Water quality, Legislation, Groundwater pollution.

Municipal planners, health officials and water superintendents should modify their management practices and regulations now to protect groundwater supplies from contamination, rather than waiting until more standards are developed and testing abilities improve. Local officials can initiate protective measures by prepairing an aquifer protection plan for their community or region. An aquifer protection plan should outline a strategy for protection of the drinking water source and provide necessary backup information for the various municipal agencies responsible for its implementation. In order to prepare such a strategy, the lead agency should review existing information on the quality of the municipal drinking water, locate potential contaminant sources, identify remedial measures and protection strategies, evaluate existing regulations and management practices, and propose amendments or new measures where appropriate. (Baker-IVI)
W84-04205

IRON SPECIATION IN ACID MINE EFFLUENTS: CHEMICAL AND MICROBIAL CONTROLS,
Ohio State Univ., Columbus. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W84-04230

A WATER HANDBOOK FOR METAL MINING OPERATIONS,
Colorado School of Mines, Golden. Dept. of Chemistry and Geochemistry.
For primary bibliographic entry see Field 5B.
W84-04233

REGULATION OF LAND USE PRACTICES FOR AREAS SURROUNDING AQUIFERS - ECONOMIC AND LEGAL IMPLICATIONS,
Connecticut Univ., Storrs. Dept. of Business Environment and Policy.
For primary bibliographic entry see Field 6E.
W84-04234

WATER QUALITY MANAGEMENT DECISIONS ON TWO OKLAHOMA STREAMS,
Corps of Engineers, Tulsa, OK.
R. C. Hunter, J. H. Carroll, and J. C. Staves.
Journal of the Water Pollution Control Federation, Vol. 56, No. 3, p 274-279, March, 1984. 4 Fig, 2 Tab, 21 Ref.

Descriptors: *Planning, *Evaluation, *Water quality management, *Oklahoma, East Cache Creek, Cow Creek, Economic aspects, Water pollution control, Flow augmentation, Dissolved oxygen, Regulations, Wastewater treatment facilities, Decision making.

Decisions involved in constructing a flow augmentation system for two Oklahoma streams, and illustrations of how extraneous factors abolished the need for such augmentation between the planning and implementation phases are discussed. The methodology used to determine the probable effects of flow augmentation and the associated costs are shown. Initial planning for the changes began in 1961. Between 1963 and 1980 some major changes influencing pollution loads in both the East Cache Creek and Cow Creek basins occurred including the construction of an advanced wastewater treatment plant in Lawton, the expansion and upgrading of the Ft. Sill wastewater treatment plant, population growth in the area which failed to meet the earlier predictions, a reduction in the Oklahoma dissolved oxygen standards, and dramatic increases in fuel costs leading to increased costs for pumping the flow augmentation water. A re-study of the decision was undertaken in 1981. In the final analysis, if the original course of action had been followed, it would have resulted in unnecessary annual costs of $972,000 for 18 years for a total of $1,524,000. The study also showed that efforts to improve the aquatic environment have been effective. The need for flow augmentation was eliminated, particularly in the East Cache Creek basin. Many other projects planned or implemented during the 1960s and early 1970s might be profitably re-evaluated in term of recent improvements in environmental quality. (Baker-IVI)
W84-04327

PHOSPHORUS REMOVAL IN A SEWAGE TREATMENT PLANT AND PLANT BIOMASS IN AN EFFLUENT RECEIVING LOWLAND STREAM,
East Brabant Dept. of Technology, Boxtel (Netherlands).
For primary bibliographic entry see Field 5D.
W84-04378

ESTABLISHMENT AND MANAGEMENT OF FRESHWATER MARSHES FOR MAXIMUM ENHANCEMENT OF WATER QUALITY FOR REUSE,
Michigan State Univ., East Lansing. Dept. of Zoology.
T. M. Burton, and K. E. Ulrich.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84169390, Price codes: A04 in paper copy, A01 in microfiche.

Completion Report, September, 1983. 65 p, 22 Fig, 8 Tab, 44 Ref. Project No. OWRT B-055-MICH(1), Contract/Grant No. 14-34-0001-0267.

Descriptors: Marshes, *Wetlands, Municipal wastewater, Storm wastewater, *Cycling nutrients, *Marsh plants, *Wastewater renovation, Wastewater treatment, Phosphorus, Nitrogen, Potassium, Phragmites, Zizania, Typha, Sparganium, Spartina, Elodea, Plant growth.

The objective of this study was to provide information (1) on growth and nutrient uptake responses of marsh plants to variable loading rates of N, P, and K and (2) on the response of these plants to various harvest regimes as background information for the design, maintenance, and operation of natural or artificial marshes for water quality enhancement. Five species of highly productive common marsh plants were grown in large pots with various loading rates of nitrogen, phosphorus, and potassium plus an excess of other necessary plant nutients. The five species were the common reed (Pragmites australis), wild rice (Zizania aquatic), two species of cattail (Typha latifolia and T. angustifolia), and burreed (Sparganium eurycarpum). In general, all five species responded with increased growth to increases of N and P alone or especially in combination up to a maximum of 468 N/ha and 125 kg P/ha. Growth of S. eurycarpum was inhibited at loading rates of 936 kg N/ha. The two species of cattail were the most productive of the five species at higher loading rates. The potassium contained in the low nutrient and medium used in these experiments was adequate for growth of all species, and added K caused little or no increase in growth. Experiments on establishment and harvest of these five species plus prairie cordigrass (Spartina pectinata) were attempted. Successful establishment and harvest of the two species of cattail and burreed was achieved. These three species only tolerated one harvest per year; multiple harvesting led to decline in biomass the following year. Nutrient budgets for three 0.47 artificial marshes indicated excellent removal of N by these marshes, but little P removal occurred.
W84-04409

EFFECTS OF ANURAN LARVAE ON AQUATIC PROCESSES ASSOCIATED WITH WATER QUALITY,
New Hampshire Univ., Durham. Water Resources Research Center.
J. T. Taylor, and C. Duerring.
Available from the National Technical Information Services, Springfield, VA 22161, as PB84163161, Price codes: A04 in paper copy, A01 in microfiche. Research Report 42, July, 1983. 50 p, 12 Fig, 6 Tab, 28 Ref. Project No. OWRT A055-NH(2), Contract/Grant No. 14-34-0001-2131.

Descriptors: *Anuran larvae, *Cyanobacteria, Sedimentation, *Decomposition, Water clarity, *Eutrophication, Algal control, Water quality, Water pollution control, Water pollution effects, Sediments.

Laboratory and field experiments and field observations were conducted to assess the role of native anuran larvae in several ecosystem processes associated with water quality. The impacts were investigated of these animals on populations of problem-causing toxic cyanobacteria, on rates of sedimentation and water clearing, on rates of decomposition of sediments and on export of biomass from aquatic to terrestrial systems. Anuran larvae were killed by intraperitoneal injection of the toxic cyanobacteria Aphanizomenon flosaquee and Anabaena flosaquae, but were unaffected by injections of Anacystic aeruginosa. All three species of cyanobacteria were effectively ingested by anuran larvae without ill effects; the filimentous forms were quickly exterminated from experimental chambers. Cyanobacteria were not a good ration for the larvae, as they lost weight rapidly on a diet of pure cyanobacteria. Anuran larvae were extremely effective at removing suspended sediments (tripton) from the water column, increasing light transmission through water much more rapidly than would occur through physical settlement. Sediments (tripton) from the water column, increasing light transmission through water much more rapidly than would occur through physical settlement. Sediments processed by anuran larvae and released as feces decomposed much more rapidly than unprocessed sediments. These results suggest that anuran larvae could have major effects on algal blooms, water clarity, and decomposition rates.
W84-04410

STRATEGIES FOR SALINITY CONTROL FOR THE UPPER COLORADO RIVER BASIN,
R. G. Evans, W. R. Walker, and G. V. Skogerboe.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 3, p 738-742 and 747, May-June, 1983. 5 Fig, 2 Tab, 17 Ref.

Descriptors: *Salinity control, *Upper Colorado River Basin, *Cost analysis, Canals, Laterals, On-farm improvements, Optimization, Water pollution control, Water quality control.

A multi-level nonlinear optimization procedure was utilized to develop an array of strategies for the most cost-effective salinity control program for the Upper Colorado River Basin. Cost effectiveness functions were developed for each point source control project for the major canals, aggregate laterals and selected on-farm improvements in each agricultural area designated in Public Law: 93-320. Marginal cost analysis showed that a cost-effective Upper Basin salinity control program would cost $30 million annual and remove 1.2 million megagrams of salt each year. Sensitivity analysis indicated that very large errors in costs and component salt contributions would have to be evident to change the order of the optimal salinity strategy. The results quantitatively indicate the location and general types of alternatives to be implemented and the associated annual costs for any selected level of basin-wide control. (Author's abstract)
W84-04434

DEWATERING DREDGED SEDIMENT FOR AGRICULTURE,
Illinois Univ. at Urbana-Champaign. Dept. of Agronomy.
For primary bibliographic entry see Field 4A.
W84-04444

COMPARISON OF RUNOFF QUALITY FROM CATTLE FEEDING ON WINTER PASTURES,
Idaho Univ., Moscow.
For primary bibliographic entry see Field 5B.
W84-04460

MODELING DAIRY WASTE MANAGEMENT SYSTEMS' INFLUENCE ON COLIFORM CONCENTRATION IN RUNOFF,
Oregon State Univ., Corvallis. Dept. of Agricultural Engineering.
J. A. Moore, M. E. Grismer, S. R. Crane, and J. R. Miner.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 4, p 1194-1200, July-August, 1983. 1 Fig, 8 Tab, 55 Ref.

Descriptors: *Waste treatment, *Dairy industry, *Runoff, *Coliforms, Animal wastes, Waste management, Land application, Water pollution control, Watersheds, Bacteria.

A model is presented which is based upon a mass balance where the effects of significant factors on bacteria populations are quantified and summed for a specific time increment. These factors include number of cows in the herd, type, capacity and management of waste storage unit, bacterial die-off in storage, waste application method and rate, bacterial die-off on the surface, precipitation, infiltration of water and bacteria, and finally, transport. The information gathered from application of the model suggests the following facts for minimizing the bacterial pollution potential of land-applied dairy wastes. Storage will markedly decrease pollution of surface waters. Drainlines will reduce runoff volume and the transport of bacteria. Spreading wastes on well-draining soils in the winter helps to decrease pollution potential. Buffer zones are an effective waste management procedure in reducing the quantity of pollution entering streams. Heavy application rates of wastes increase pollution potential. Runoff from barnyards laden with stacked animal wastes possesses the greatest pollution potential. (Baker-IVI)
W84-04461

REGULATING HAZARDOUS CHEMICALS IN AQUATIC ENVIRONMENTS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
J. Cairns, Jr.
Boston College Environmental Affairs Law Review, Vol. 11, No. 1, p 1-10, 1983. 1 Fig, 25 Ref.

Descriptors: *Regulations, *Hazardous materials, Decision making, Aquatic environment, Water quality control, Environmental effects.

Current regulatory and scientific approaches to the presence of hazardous substances in an aquatic environment are examined. Implementation of a specific hazard evaluation process is recommended to ameliorate the inadequacies of present approaches. Evidence is overwhelming that the unmanaged environment cannot always assimilate or recover from anthropogenic stresses including toxic wastes, surface mining and acid rain. Solutions to the major problems require the collaboration of a diverse array of disciplines that are typically isolated from each other and unaccustomed to substantive interactions. The reemergence of integrative science characteristic of the period before the era of specialization is essential. The essence of the information learned must be communicated to laymen, used to make decisions, and incorporated into useful regulations. (Baker-IVI)
W84-04532

DEVELOPMENT OF A NATIONAL GROUNDWATER PROTECTION POLICY,
For primary bibliographic entry see Field 6E.
W84-04533

ST. JOHN'S HARBOUR WATER QUALITY MODEL,
Gore and Storrie Ltd., Toronto (Ontario).
R. J. Dewey, and M. D. Palmer.
Canadian Journal of Civil Engineering, Vol. 11, No. 1, p 65-73, March, 1984. 5 Fig, 3 Tab, 13 Ref.

Descriptors: *St. John's Harbor, *Water quality model, Model studies, Water quality, Computer models, Water currents, Water level, Hydrologic models Management planning, Project planning.

At St. John's Harbor, Newfoundland, the city wants to enhance the water quality of this historic harbor by a staged capital works program over a period of years. A dynamic two-dimensional numerical water quality model was developed to assist in providing direction for a water quality enhancement program. The model input parameters were adjusted until the model outputs of water levels, currents, and water quality concentrations matched collected field data which included measurements of the sewer discharges. The tidal stage for the most degraded harbor water quality was identified. This stage was used to compare the harbor water quality enhancements and degradations for different management scenarios which included combining and relocating discharges, partial treatment of some discharges, and some direct ocean discharge. By using the model in a comparative manner, the requirements for model verification are reduced as are some of the errors in the modelling process. (Murphy-IVI)
W84-04550

AQUIFER RECLAMATION DESIGN: THE USE OF CONTAMINANT TRANSPORT SIMULATION COMBINED WITH NONLINEAR PROGRAMING,
Geological Survey, Reston, VA.
S. M. Gorelick, C. I. Voss, P. E. Gill, W. Murray, and M. A. Saunders.

Water Resources Research, Vol. 20, No. 4, p 415-417, April, 1984. 8 Fig, 4 Tab, 44 Ref. NSF grant ECS-8012974.

Descriptors: *Aquifer reclamation, *Contaminant Transport Simulation, *Nonlinear programming, Simulation analysis, Model studies, Optimum development plans, Optimization, Reclaimed water, Groundwater pollution, Water pollution treatment, Water quality management, Groundwater management.

A simulation-management methodology is demonstrated for the rehabilitation of aquifers that have been subjected to chemical contamination. Finite element groundwater flow and contaminant transport simulation are combined with nonlinear optimization. The model is capable of determining well locations plus pumping and injection rates of groundwater quality control. Examples demonstrate linear or nonlinear objective functions subject to linear and nonlinear simulation and water management constraints. Restrictions can be placed on hydraulic heads, stresses, and gradients, in addition to contaminant concentrations and fluxes. These restrictions can be distributed over space and time. Three design strategies are demonstrated for an aquifer that is polluted by a constant contaminant source: they are pumping for contaminant removal, water injection for in-ground dilution, and a pumping, treatment, and injection cycle. A transient model designs either contaminant plume interception or in-ground dilution so that water quality standards are met. The method is not limited to these cases. It is generally applicable to the optimization of many types of distributed parameter systems. (Author's abstract)
W84-04565

APPLICATION OF STOCHASTIC DISSOLVED OXYGEN MODEL,
Gore and Storrie Ltd., Toronto (Ontario).
R. J. Dewey.
Journal of Environmental Engineering, Vol. 110, No. 2, p 412-429, April, 1984. 9 Fig, 2 Tab, 21 Ref.

Descriptors: *Dissolved oxygen, *Model studies, *Stochastic process, Mathematical models, Water pollution control, Water quality control, Pollution load, Receiving water.

A stochastic dissolved oxygen river model is developed based on modifications of a set of random differential equations after Streeter and Phelps. The method uses randomly generated rate constants and input parameters which are described by probability distributions determined from survey data means and their standard deviations to generate the probable dissolved oxygen levels in a river. The model is used to predict the effect of wastewater loadings from water pollution control plants on the dissolved oxygen level in the receiving river. The model is applied to the Thames River, London, Ontario, to determine if flow augmentation would reduce the number of episodes of low dissolved oxygen in the river during the low flow seasons. In addition, the model was used to test if improved treatment in the water pollution control plants would alleviate the low dissolved oxygen level in the river. The model results indicate that flow augmentation is not required if the water pollution control plants produce improved effluent. (Author's abstract)
W84-04598

INTERACTIVE WATER QUALITY SIMULATION IN A REGIONAL FRAMEWORK: A MANAGEMENT ORIENTED APPROACH TO LAKE AND WATERSHED MODELING,
International Inst. for Applied Systems Analysis, Laxenburg (Austria).
For primary bibliographic entry see Field 2A.
W84-04671

ECOLOGICAL EFFECTS OF LIME TREATMENT OF ACIDIFIED LAKES AND RIVERS IN SWEDEN,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
F. Eriksson, E. Hornstrom, P. Mossberg, and P. Nyberg.
Hydrobiologia, Vol. 101, No. 1/2, p 145-164, April, 1983. 18 Fig, 10 Tab, 57 Ref.

Descriptors: *Ecological effects, *Lime treatment, *Acidic lakes, *Acidic streams, *Sweden, Acidic water, Lime, Phytoplankton, Macrophytes, Zooplankton, Benthos, Fish, Lake restoration, Biological properties.

Effects on the aquatic biota of lime ($CaCO_3$) application in acidified lakes and streams were studied in a number of waters. After treatment, lime-sensitive species of mosses (Sphagnum spp.) decreased, but species such as Potamogeton natans and Myriophyllum alterniflorum seemed to be favoured. A few years after liming species composition and diversity of phytoplankton, zooplankton and benthic insect larvae were almost identical to that found in oligotrophic and non-acid lakes. Mollusks and benthic crustaceans may have difficulties recolonizing. Reproduction of remaining species of fish was successful as soon as pH increased. High survival of larvae and fry can result in some extremely rich year classes with slow individual growth. In most cases restocking of depleted fish stocks was successful. (Author's abstract)
W84-04709

ECOLOGICAL CLASSIFICATION OF THE QUALITY OF CONTINENTAL SURFACE WATERS,
Limnologicheskii Inst., Irkutsk (USSR).
V. V. Cherepanov.
Hydrobiological Journal, Vol. 19, No. 2, p 43-45, 1983. 5 Ref.

Descriptors: *Water quality, *Standards, *USSR, Decision making, Lakes, Streams, Water use, Surface waters.

A critical appraisal of the ecological classification of the water quality standard as proposed by Zhukinskiy and Oksiyuk (1976, Gidrobiol. 12(6):103-111) is presented. Zhukinskiy et al. have suggested five grades of water quality. They also have suggested nine finer gradations. The current authors take exception to the standard as proposed, suggesting that the quality of water can be classified only in terms of the requirements of a particular technology of water utilization. Therefore, a classification of water quality can be constructed on the basis of USSR State Standards that define water quality in relation to specific modes of water use. Such standards should include technical specifications on gas content and temperature of the water, acidity, dissolved, suspended and toxic substance contents, and also biological properties. From such standards of water quality a classification of lakes and streams can be developed which, in turn, can be used in a survey of waters of the USSR and as a basis for the system of water conservation. (Baker-IVI)
W84-04724

METHODOLOGICAL BASIS FOR ECOLOGICAL CLASSIFICATION OF THE QUALITY OF CONTINENTAL SURFACE WATERS,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
V. N. Zhukinskiy, and O. P. Oksiyuk.
Hydrobiological Journal, Vol. 19, No. 2, p 46-53, 1983. 22 Ref.

Descriptors: *Water quality, *Surface waters, Classification, Ecology, Standards, Continental hydrology, Water management, Economic aspects.

The methodological basis for evolving an ecological classification of the quality of continental waters is discussed. This classification seems better than other available descriptions of water quality and is useful in water management and planning of water conservation measures. The quality of continental surface water is determined by its composition and properties. The quality of surface water is not always a reflection and product of the ecosystem. In some cases, as for springs, geysers, and at the fringe of glaciers, water also has a specific composition and set of properties that define its qualitative differences from other waters. Given the theory of dialectic materialism, the need exists to differentiate between the ecological and economic viewpoints on water quality. Hydrologists are faced with the problem of defining a quantitative scale for purposes of comparison of the major natural indicators of composition and properties of water. The purpose of such a scale would be conversion of these indicators to specific quantitative gradations of water quality. Many systems of hydrological analysis of water quality already exist, all based on different principles and methods of quality assessment. Ecological classifications attempt to give a combined description of surface waters on the basis of the most representative parameters of their composition and properties. (Baker-IVI)
W84-04725

HYPOLIMNETIC AERATION: CHANGES IN BACTERIAL POPULATIONS AND OXYGEN DEMAND,
York Univ., Downsview (Ontario). Dept. of Biology.
D. J. McQueen, S. S. Rao, and D. R. Lean.
Archive fur Hydrobiologie, Vol. 99, No. 4, p 498-514, 1984. 6 Fig, 5 Tab, 65 Ref.

Descriptors: *Aeration, *Dissolved oxygen, *Bacteria, *Lake St. George, *Ontario, Hypolimnion, Heterotrophic bacteria, Winterkill, Oxygen demand, Seasonal variation.

The effects of hypolimnetic aeration on bacterial populations and oxygen depletion rates were investigated at Lake St. George, Ontario, using two experimental enclosures (aerated and control) 8 m in diameter by 14 m deep and open to the mudwater interface. The experiment began on June 17, 1980 and ended on October 27, 1981. Total bacteria and respiring bacteria were measured using the INT-formazan reduction technique and aerobic heterotrophic bacteria were measured by the plate count procedure. Throughout the experiment there were no significant differences in any of these counts when the aerated and control enclosures were compared. Also, in the deep (8, 12 and 14 m) samples, total and % respiring bacteria were not related to oxygen concentrations, but both changed with season. Despite these results, hypolimnetic oxygen demand was much greater (0.5 to 0.9 mg/l/d) in the aerated enclosure than in the control which contained almost no oxygen. These results suggest that aerator designs must include substantial allowances for induced oxygen demand. They also suggest that the INT-formazan reduction technique might be unable to detect the increased bacterial activity caused by the addition of oxygen to hypolimnetic water. Finally, the enclosures did not receive any air during the winter and the enclosure that had received summer aeration suffered from winter kill, whereas the control showed a normal oxygen profile. This suggests that summer aeration creates an abnormally high winter oxygen demand so that winter aeration may also be necessary. (Author's abstract)
W84-04756

HYPOLIMNETIC AERATION AND ZOOPLANKTON DISTRIBUTION: A POSSIBLE LIMITATION TO THE RESTORATION OF COLD-WATER FISH PRODUCTION,
York Univ. (England). Dept. of Biology.
C. T. Taggart.
Canadian Journal of Fisheries and Aquatic Science, Vol. 41, No. 1, p 191-198, January, 1984. 6 Fig, 1 Tab, 32 Ref.

Descriptors: *Lake restoration, *Aeration, *Zooplankton, Crustaceans, Rotifers, Hypolimnion, Predation, Kettle lakes, Fish food, Anoxic conditions, Toxicity, Metalimnion.

Hypolimnetic aeration of a 1.23-ha eutrophic kettle lake during two consecutive summers increased (O_2) to more than 4 mg/L in the hypolimnion for extended periods. This improvement did not lead to the expected development of crustacean populations in the previously anoxic, zooplankton-deficient hypolimnion. The rotifer Filinia longiseta was the only zooplankter present, as isolated populations, in both the epilimnion and hypolimnion

during summer. Eighty percent of the summer zooplankton community occurred exclusively in the epilimnion, and this was related to the development of an anoxic and toxic metalimnion that restricted migration from the epilimnion to the hypolimnion. Confinement of the zooplankton to the epilimnion coupled with predation by fathead minnows (Pimephales promelas) appeared to be responsible for the change in the zooplankton community from large cladocerans and copepods to smaller species. Hypolimnetic aeration as a means of restoring or enhancing the production of cold-water fish may be thwarted by the development of a stable anoxic and toxic metalimnion that precludes the development of the zooplankton food resource. (Author's abstract)
W84-04765

RESULTS AND GOALS OF RATIONAL WATER USE AND WATER CONSERVATION IN SOCIALIST AGRICULTURE (ERGEBNISSE UND AUFGABEN BEI DER RATIONELLEN WASSERVERWENDUNG UND DEM SCHUTZ DER GEWASSER IN DER SOZIALISTISCHEN LANDWIRTSCHAFT),
For primary bibliographic entry see Field 3F.
W84-04785

THE CONTRIBUTION OF SOCIALIST AGRICULTURE TO THE IMPLEMENTATION OF THE SPECIFICATIONS OF THE NEW WATER LAW (DER BEITRAG DER SOZIALISTISCHEN LANDWIRTSCHAFT ZUR DURCHSETZUNG DER BESTIMMUNGEN DES NEUEN WASSERGESETZES),
For primary bibliographic entry see Field 3F.
W84-04786

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

MEDIATION IN THE ESTUARY,
Conservation Foundation, Washington, DC.
S. Gusman, and V. Huser.
Coastal Zone Management Journal, Vol. 11, No. 4, p 273-295, 1984. 26 Ref.

Descriptors: *Estuaries, *Mediation, Port facilities, Management planning, Regional development, Resources development, Water resources development, Policy making, Columbia River esturary, Decision making, Administration.

Certain key disputes remained unresolved after extensive efforts by the Columbia River Estuary Study Taskforce (CREST) to develop a management plan for the estuary and its shorelands. The remaining disputes, involving conflicts between resource protection and port development, were resolved by the mediation process. This process, involving exploration, process design, negotiation, and implementation phases, led to the signing of an agreement by twelve negotiators, the subsequent endorsement of the agreement by the federal, state, and local governmental bodies they represented, and the incorporation of the terms of the agreement into the comprehensive plans of local governments. The agreement describes the particular kinds of port-related development that might be appropriate at specific sites in the estuary and the conditions under which such development might take place. It also outlines areas where development alteration would not occur. For some of the sites it presents constraints on dredge-and-fill activities, turning basin and navigation-channel depths and widths, corridors for pile supported causeways and accessways, and mitigation policies. (Murphy-IVI)
W84-04196

DEVELOPMENT AND APPLICATION OF MODELS FOR PLANNING OPTIMAL WATER REUSE,
Texas Univ. at Austin. Center for Research in Water Resources.
For primary bibliographic entry see Field 3C.
W84-04240

THE APPLICATION OF A MANAGEMENT MODEL TO A RURAL WATER SUPPLY PROJECT IN MALAWI,
Birmingham Univ. (England). Inst. of Local Government.
C. F. Palmer.
Journal of the Institution of Water Engineers and Scientists, Vol. 37, No. 6, p 523-528, December, 1983. 5 Fig, 7 Ref.

Descriptors: *Planning, *Water supply development, *Malawi, *Wells, Water supply, Water resources development, Drinking water, Developing countries.

This project was designed to supply safe drinking water to 60,000 people per year in Malawi, through the construction of 600 hand-dug wells, each serving a population of about 100. The overall responsibility for managing the project came under the wells engineer. A vital requirement for the success of the project was for the voluntary community to be properly organized in order to have the well digging completed before the arrival of a skilled crew to carry out the well-lining and the installation of the pumps. The project objectives were not achieved by the end of 1980 and a further assessment of the organizational model and the logical framework and matrix with the monitoring system was carried out. The main reasons for the failure could be attributed to poor management and particularly to the control aspect, despite the assistance of the logical framework and system adopted for monitoring. Network planning was then applied. The network technique was a great success, particularly when used in conjunction with complementary management aids such as the Gnatt chart and resource bar and histogram. (Baker-IVI)
W84-04315

GUIDELINES FOR IMPROVED INSTITUTIONAL ANALYSIS IN WATER RESOURCES PLANNING,
Arizona Univ., Tucson. Dept. of Political Science.
H. M. Ingram, D. E. Mann, G. D. Weatherford, and H. J. Cortner.
Water Resources Research, Vol. 20, No. 3, p 323-334, March, 1984. 47 Ref.

Descriptors: *Institutional constraints, *Planning, Water resource development, Decision making.

Institutional factors are often among the most formidable obstacles to the development and implementation of feasible water resource programs. Guidelines for gathering and analyzing information on institutional factors as part of water resource planning and evaluation activities are presented. In approaching the analysis of current institutional arrangements, analysts should pay particular attention to (1) the actors and their stakes in the decision-making process; (2) the political and decision-making resources actors have available to pursue their interests; and (3) the biases of the alternative decision-making structures, through which various water resource decisions are made. While institutional analysis can pinpoint important barriers and constraints to plan implementation, it is of most use when it goes beyond a description and analysis of current institutional arrangements to assess possible strategies and solutions that can be applied to the problems identified. (Author's abstract)
W84-04357

STOCHASTIC STREAMFLOW MODELS FOR HYDROELECTRIC SYSTEMS,
Centro de Pesquisas de Energia Electrica, Rio de Janeiro (Brazil).
For primary bibliographic entry see Field 2E.
W84-04362

MODELING OF WATER QUANTITY AND QUALITY FOR RIVER BASIN PLANNING,
New Hampshire Univ., Durham. Water Resources Research Center.
S. L. Dingman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84163179, Price codes: A05 in paper copy, A01 in microfiche. Research Report 39, April, 1983. 78 p, 19 Fig, 2 Tab, 25 Ref, 3 Append. Project No. OWRT A-059-NH (2), Contract/Grant No. 14-34-0001-2131.

Descriptors: *River basins planning, Water quality, *Dissolved oxygen, *Phosphorus, *New Hampshire, Merrimack River, *Model studies, Water pollution sources, Nonpoint pollution sources, Water pollution effects.

The objective of this study was to develop and test a river-basin planning model incorporating the effects of point and non-point sources of pollution on water quality. The model simulates the quantity and quality relations in a river network under critical low-flow conditions, and incorporates precise and hydrologically sound definitions of demand and supply. Flow and water quality are modeled at use sites (municipalities or industrial locations) by simple equations that allow planners to evaluate the effects of a complete set of structural and non-structural alternatives for meetng future water demands. The model was used to compute critical dissolved-oxygen concentrations for the Merrimack River Basin in New Hampshire, and showed encouraging correpondence with measured values. Phosphorus is also an important water-quality constituent, and extensive field studies of the behavior of that element were carried out in southeastern New Hampshire to elucidate its behavior in stream networks. It was found that given stream reach acts as a source of phosphorus under some conditions and a sink under others. It appeared that a chemical-kinetic effect and the erosion and deposition of fine sediments largely controlled this behavior. The study has established the need for water-resource planning models, described the specific elements of such models, demonstrated the feasibility of developing and applying such models in New England, and identified specific areas where research will contribute to the improvement of planning models.
W84-04411

WATER CONSERVATION: THE STRUGGLE OVER DEFINITION,
Southern Illinois Univ. at Carbondale. Dept. of Geography.
For primary bibliographic entry see Field 3D.
W84-04566

INFORMATION RETRIEVAL FOR THE PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT,
Quebec Univ., Sainte-Foy.
D. Couillard.
Journal of Environmental Systems, Vol. 13, No. 3, p 205-230, 1983-84. 9 Tab, 86 Ref. National Research Council of Canada grant A3711.

Descriptors: *Information retrieval, *Environmental impact statement, Water quality management, Resources management, Water management, Optimum development plans, Land use, Quebec, Canada.

A study of the possible advantages of land use analysis (land indicators) appears to be a necessary preliminary step to the selection of data for acquisition. Researchers who report data on the physical, chemical and biological quality of water always do so with reference to the land in the basin under study. Two pertinent questions which arise are therefore: just how far should this analysis go; and how should results be optimally used to solve problems relating to water quality. This article should therefore be considered as a preliminary study towards the development of an integrated method for water quality data acquisition. The choice of data is approached from the perspective of land use and the way in which the data are to be used. This paper is intended to give a general idea of the physical and human characteristics of watersheds. This appreciation of a basin constitutes the first step in the determination of the problems of environmental impacts. For the Province of Quebec (Canada) as a case study, this publication

provides a list of the main reference documents and sources of data on the physical and human characteristics of basins. At first sight, there is virtually no need to collect additional data for the purpose of preliminary interpretation of water quality data. (Author's abstract)
W84-04604

THE METROPOLITAN WATER ROUNDTABLE: RESOURCE ALLOCATION THROUGH CONFLICT MANAGEMENT,
ACCORD, Los Altos, CA.
W. J. D. Kennedy, and H. Lansford.
Environmental Impact Assessment Review, Vol. 4, No. 1, p 67-78, March, 1983. 1 Fig.

Descriptors: *Water management, *Planning, *Decision making, *Denver, *Colorado, Water supply, Roundtable, Management techniques.

Two facts underlie every decision about the allocation and use of water in Colorado: it is naturally scarce and it is legally transferable. Because of these factors it responds to market forces. Proposals for meeting the future water needs of metropolitan Denver have been the subject of intense dispute and costly litigation for decades. Although Denver has been diverting water from the western slope of the Rocky Mountains since the 1930s, its attempts to pursue further diversions are fraught with controversy. A new approach to water management planning was adopted, called the Roundtable. A set of rules which were to be used in meetings attended by committee members is described. The most dramatic accomplishment of the Roundtable was the draft water development agreement, which was unprecedented in the history of the state. However, other accomplishments were also made, including the development of a deeper understanding among the various interest groups and respect for each others opinions. Before the Roundtable experience most of these groups would not talk with each other, let alone work together. The Metropolitan Water Development Agreement is an agreement between the Denver Water Department and almost fifty suburban water providers to share the costs and yields of future metropolitan water development. All the people who initiated this novel approach to development and funding were either Roundtable members or invited observers. (Baker-IVI)
W84-04613

THE 29TH CONFERENCE OF THE HEADS OF WATER MANAGEMENT AGENCIES OF COMECON MEMBER COUNTRIES IN CUBA (29. TAGUNG DER LEITER DER WASSERWIRTSCHAFTSORGANE DER MITGLIEDSLANDER DES RGW IN KUBA),
H.-J. Machold.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 3, p 91-92, March, 1983.

Descriptors: *Water management, *Planning, *Conference, Water pollution control, Wastewater treatment, Water reuse, Water use, Automation.

The 29th Conference of the Heads of Water Management Agencies (WMA) of COMECON member countries took place from 13 to 18 September 1982 in Havana, Cuba. The Cuban conference president reported on the political and economic results of cooperation with COMECON countries over the past 20 yr on in the water management field: it was determined that work on more than 70 complex scientific and technological problems had been effective in long-term water management planning within the framework of total economic planning, in analysis and rational use of water resources, and in water pollution prevention. The work also yielded a prognosis on water management development within COMECON until 1990. Results of studies carried out since 1966 concerning the creation of 1,714 standards for water and wastewater in specific industries and agriculture were announced together with the development of process analysis in industry for the purpose of the introduction of closed water circuits. Principles for assessing the effects of the chemicalization of agriculture on water quality and for the forecasting of water quality at wastewater inlet points had been worked out. Since 1976, the terminology of 15 standard and > 1,500 scientific terms has been defined. Much time was spent on future directions in technological research and continued progress in COMECON's complex water plan, particularly with regard to rational water use and automation. Research on microprocessors and the creation of COMECON standards for apparatus and equipment will occur. (Gish-IVI)
W84-04780

THE ACHIEVEMENTS OF CUBAN WATER MANAGEMENT - 20 YEARS OF WASTE MANAGEMENT IN THE REPUBLIC OF CUBA (DIE ERRUNGENSCHAFTEN DER KUBANISCHEN WASSERWIRTSCHAFT - 20 JAHRE WASSERWIRTSCHAFT IN DER REPUBLIK KUBA),
For primary bibliographic entry see Field 4A.
W84-04781

6B. Evaluation Process

FACING THE LAKE: THE COASTWATCHERS OF RACINE COUNTY, WISCONSIN,
Wisconsin Univ.-Madison. Sea Grant Inst.
J. P. Keillor, and B. Gruning.
Coastal Zone Management Journal, Vol. 11, No. 4, p 297-315, 1984. 2 Fig, 27 Ref.

Descriptors: *Erosion control, *Racine County, *Wisconsin, *Lake Michigan, *Lake shores, Great Lakes, Waves, Shore protection, Beaches, Coastal zone management, Surface runoff, Storm seepage.

Shoreline erosion and coastal development are management issues in the Great Lakes region that have been examined over the past four years by local governments in Racine County (Wisconsin) with trained volunteers gathering information so that a timely management of coastal development can occur. The objectives of the Racine Coastwatch Program are to understand the effects and importance of wave action on shoreline erosion, on beaches, and on shore protection structures; to provide data which will supplement and extend the geographical significance of data gathered by researchers at coastal monitoring sites in neighboring countries; to observe events such as fish die-offs, algal blooms, and oil spills; and to learn how well a volunteer program can function, and how much coastline an observer can watch. The coastwatchers gave Racine County a line of observers to provide an early warning of problems and some understanding of how the lake influences the coast. The county and towns learned that two processes amenable to control, surface runoff and subsurface seepage, are important factors in local bluff slumping. The coastwatch information was transferred into management practices in a number of instances. (Baker-IVI)
W84-04197

COST-EFFECTIVENESS OF THE STREAM-GAGING PROGRAM IN MAINE,
Geological Survey, Augusta, ME. Water Resources Div.
R. A. Fontaine, M. E. Moss, J. A. Smath, and W. O. Thomas, Jr.
USGS Open-File Report 83-261, 1983. 81 p, 17 Fig, 17 Tab, 23 Ref.

Descriptors: *Hydrologic data, *Stream-gaging, Stream discharge, Data use, *Maine, Program analysis, Risks, *Cost-effectiveness.

Data uses and funding sources were identified for the 51 continuous stream gages currently being operated in Maine. Three stream-gages were identified as having insufficient reason to continue their operation. Operation of these stations were identified as having uses specific only to short-term studies; it is recommended that these stations be discontinued at the end of the data-collection phases of the studies. The remaining 45 stations should be maintained in the program for the foreseeable future. The current policy for operation of the 45-station program would require $180,300 per year. The average standard error of estimation of streamflow record is 18.5 percent. It was shown that this overall level of accuracy at the 45 sites could be maintained with a budget of $170,000 if the gaging resources were redistributed among the gages. A minimum budget of $155,000 is required to operate the 45-gage program; a budget less than this does not permit proper service and maintenance of the gages and recorders. At the minimum budget, the average standard error is 26.0 percent. The maximum budget analyzed was $350,000, which resulted in an average standard error of 9.2 percent. Large parts of Maine's interior were identified as having sparse stream-flow data. It was recommended that this sparsity should be remedied as funds can be made available. (USGS)
W84-04246

WATER QUALITY MANAGEMENT DECISIONS ON TWO OKLAHOMA STREAMS,
Corps of Engineers, Tulsa, OK.
For primary bibliographic entry see Field 5G.
W84-04327

APPLIED SIMILARITY CRITERIA IN THE SCALE-UP FROM EXISTING TO LARGE MSF DESALINATION PLANTS,
Aquila Univ. (Italy). Facolta di Ingegneria.
For primary bibliographic entry see Field 3A.
W84-04553

DEVELOPING JOINT WATER PROJECTS,
Black and Veatch, Kansas City, MO.
R. D. Hardten.
American Water Works Association Journal, Vol. 76, No. 4, p 131-133, April, 1984. 2 Fig, 1 Tab.

Descriptors: *Planning, *Water distribution, *Water treatment, *Utilities, Decision making, Water supply development, Economic aspects, Economies of scale, Municipal water, Rural areas, Cost sharing.

Because of the magnitude of current and projected costs associated with constructing major water utility facilities, more innovative methods are required to raise needed capital. One method for water utilities is to use joint development and cost sharing, which result in effective planning, sharing risks, sharing resources, eliminating duplication of effort, and economies-of-scale. The cost of financing improvements can be shared by each party, based on expected future requirements. Central cities with declining populations would not be burdened with subsidizing suburban growth. The suburbs would benefit by the increased probability that a reliable system, adequate to meet their needs, will be built and maintained. The advantages of joint project development and cost sharing can benefit both central cities and suburbs. (Baker-IVI)
W84-04581

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

ELASTICITY OF DEMAND FOR RESIDENTIAL WATER: POLICY IMPLICATIONS FOR SOUTHERN ARIZONA,
Arizona Univ., Tucson. Coll. of Business and Public Administration.
For primary bibliographic entry see Field 3D.
W84-04388

6D. Water Demand

SOURCE, USE, AND DISPOSITION OF WATER IN FLORIDA, 1980,
Geological Survey, Tallahassee, FL. Water Resources Div.
S. D. Leach.
Available from the Ofss, USGS, Lakewood CO 80225, Price: $44.50 paper copy, $3.50 microfiche. USGS Water-Resources Investigations Report 82-4090, 1983. 337 p, 27 Fig, 45 Tab, 35 Ref.

Descriptors: *Florida, *Water use, *Water utilization, Waterworks, *Watersheds, Agriculture, Areal hydrogeology, Consumptive use, Freshwater, *Groundwater, Hydrology, Industrial water, *Irrigation, Irrigation water, Acreage, Basins, Saline water, Supply, *Surface water.

An average of 21,206 million gallons of water was withdrawn for use in Florida each day for the combined use for public supplies, rural domestic and livestock, industrial self-supplied, irrigation, and thermoelectric power generation. This amount, broken down into 7,309 millions gallons per day of freshwater and 13,897 million gallons per day of saline water, indicates an increase of more than 40 percent for all uses during the 10-year period 1970-80. The largest user of freshwater in Florida was for irrigation--2,997 million gallons per day which also is responsible for the greatest consumption, 1,530 million gallons on the average each day or about half the water applied. The remaining use of freshwater amounted to 1,859 million gallons per day for thermoelectric power generation (which also used about 13.7 billion gallons per day of saline water); 1,361 million gallons per day of public supply; 797 million gallons per day for industrial use other than thermoelectric power generation; and 310 million gallons per day, on the average, for rural domestic and livestock use. (USGS)
W84-04261

GROUND-WATER-USE TRENDS IN THE TWIN CITIES METROPOLITAN AREA, MINNESOTA, 1880-1980,
Geological Survey, St. Paul, MN. Water Resources Div.
M. A. Horn.
USGS Water-Resources Investigations Report 83-4033, 1983. 37 p, 16 Fig, 8 Tab, 36 Ref.

Descriptors: *Water ulitization, *Groundwater, Municipal water, Industrial water, Air conditioning, Irrigation water, *Minnesota, Minneapolis-St. Paul metropolitan area, Twin Cities, Prairie due Chien-Jordan aquifer.

Detailed ground-water-use information from 1880 to 1980 has been collected and analyzed for the Twin Cities metropolitan area. Interpretation of historic water-use data was required to help water-resource planners and managers assess future trends in water use. Methods were developed to collect, evaluate, store, and retrieve information from all local, State, and Federal agencies' records and publications. A computerized water-use data base was constructed to facilitate generation of statistics on water-use trends and to store and retrieve data. Ground-water use was analyzed by use category and aquifer and several trends were observed. Eighty percent of ground water currently withdrawn is from wells in the Prairie due Chien-Jordan aquifer. Ground-water use increased from 1880 until the early 1970's and then declined slightly in the late 1970's. Industrial use in particular declined during the 1970's as a result of conservation that was prompted by increased sewage-treatment and energy costs. The intensity of pumping had decreased within the St. Paul and Minneapolis city limits and increased outside the city limits. The seasonal variability of ground-water use became more pronounced as the percentage of water used for irrigation and air conditioning increased. (USGS)
W84-04266

BASINWIDE WATER REQUIREMENT ESTIMATION IN SOUTHERN FLORIDA,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2D.
W84-04438

WATER DEMAND STANDARDS IN DAIRY FARMING (WASSERBEDARFSNORMEN IN DER RINDERPRODUKTION),
Akademie der Wissenschaften der DDR, Iden-Rohrbeck. Inst. fuer Rinderproduktion.
E. Kaiser.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 4, p 117-119, April, 1983. 5 Fig, 4 Tab, 10 Ref.

Descriptors: *Water demand, *Dairy industry, *Farms, *East Germany, Water conservation, Water management, Cattle, Cleaning.

Water demand in dairy farming in the German Democratic Republic has risen from 50-60 l/cow/day at the beginning of the 1960s to as much as 150 l/cow/day, due partly to higher standards of hygiene but also to varying management practices among farmers. If, in a milking herd of 1,930 cows, 20 l less water/cow/day were used, yearly savings would be 14,000 cu m water, 14,000 cu m liquid manure, and 16,800 kg diesel fuel and 71,000 Marks for preparation and transport of liquid manure. In order to develop standards for water demand for the industry, water volume measurements and water-management process analyses were performed for every stage of production in on 50 farms. The data collected varied widely, so that it was impossible to use mean values or progressive mean values directly as the norm for total water demand. Data for individual production stages showed that variability was due to idiosyncratic cleaning procedures and careless water use. A synthesis of the process analysis data for each production stage was therefore made to establish water use norms for a healthy herd so that satisfactory hygiene, work, and production conditions would prevail while water would be used economically. Using these norms for individual production stages, a norm for total water use for the sample herd of 1,930 cows was calculated. The practicability of the norms was tested over a four-month period in a herd of 1,930 in which water demand had been very high. (Gish-IVI)
W84-04787

PROBLEMS OF WATER DEMAND ACCORDING TO VOLUME AND QUALITY FOR THE PRODUCTION OF YOUNG FISH (PROBLEME DES WASSERBEDARFS NACH MENGE UND GUTE FUR DIE SATZFISCHPRODUKTION),
Technische Univ., Dresden (German D.R.). Bereich Hydrobiologie.
G. Bartsch.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 4, p 130-133, April, 1983.

Descriptors: *Water demand, *Fish farming, Aquaculture, Water quality, Wastewater treatment, Water supply, Dissolved oxygen, Aeration.

The Rodertal Fish Farm (RFF) has 28 pools covering 230 hectares (ha) with a total volume of 2.76 million cu m. It specializes in young fry, mostly carp, as a supplier to other farms. An increase in fish production to 140% of the present level (300 tonnes) is planned. Water is becoming the limiting factor in intensive fish farming. No evaporation or seepage measurements have been made at RFF, but experience has shown that a water inflow of 1.0 l/sec/ha is required; 0.8 l/sec/ha if the pool is surrounded by trees. Considering this 0.2 l difference, with pools filled for 320 days at RFF, there is 1.27 million cu m inflow water for which the need is not known. The maximal estimated inflow level of 5 l/sec/ha for winter pools and those in which food pellets (FP) are used cannot be met by available water supplies, though possibilities for using remote supplies are being investigated. Good water quality allows a reduction in the required level to 3 l/sec/ha; to achieve this, a fully biological wastewater treatment plant is planned for the supply river. Significant problems at RFF FP pools are created by O2 inflow levels of 1.8-2.2 mg/l where levels of 5-6 mg are needed; the feasibility of artificial enrichment is to be studied. Water demand can be reduced by constructing pools connected by cascades; however diseases are thereby more easily transmitted, and it is more difficult to combat pollution in inflow water. A compromise between water and fishing concerns must be reached. (Gish-IVI)
W84-04790

6E. Water Law and Institutions

REGULATION OF LAND USE PRACTICES FOR AREAS SURROUNDING AQUIFERS - ECONOMIC AND LEGAL IMPLICATIONS,
Connecticut Univ., Storrs. Dept. of Business Environment and Policy.
M. Huffmire, L. Frankel, and F. C. Reitman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-159763, Price codes: A16 in paper copy, A01 in microfiche. Connecticut Institute of Water Resources, Storrs, Completion Report (1982). 342 p, 6 Fig. Project No. OWRT B-015-CONN (3), Contract/Grant No. 14-34-0001-0213.

Descriptors: Aquifers, Groundwater, Aquifer protection, Cost-benefit analysis, Aquifer recharge, Water policy, *Land use, *Legal aspects, *Economic impact, Long term planning, Institutional constraints, *Connecticut, *Groundwater management, *Aquifer management, *Regional planning, Groundwater pollution control.

Regional increases in the demand for water have led to a growing desire to tap underground water sources. Evidence indicates that many of Connecticut's commercially feasible aquifers are already badly degraded, and that without immediate action to restrict harmful surface practices, they will be followed by others. Economic evidence indicates that the state as a whole can reap substantial benefits by an intelligently conceived and implemented program of land use monitoring and water resource planning, but that such a program can only be undertaken through additional legislation and funding. Current legal mechanisms for the orderly management of water resources are insufficient and need overhaul. Greater stress must be placed on comprehensive long-term planning on the regional level, and strong institutional arrangements to implement this planning process are necessary.
W84-04234

GUIDELINES FOR IMPROVED INSTITUTIONAL ANALYSIS IN WATER RESOURCES PLANNING,
Arizona Univ., Tucson. Dept. of Political Science.
For primary bibliographic entry see Field 6A.
W84-04357

DEVELOPMENT OF A NATIONAL GROUNDWATER PROTECTION POLICY,
J. S. Dycus.
Boston College Environmental Affairs Law Review, Vol. 11, No. 2, p 211-271, 1984. 390 Ref.

Descriptors: *Groundwater management, *Regulations, *Water quality control, Legislation, Policy making, Environmental Protection Agency, Hazardous materials, Waste disposal.

The Environmental Protection Agency has developed a draft proposed Groundwater Policy which in many ways resembles the old one, most importantly in its reliance on the development of effective state rules and state enforcement. The new proposal also relies upon the adequacy of existing federal statutes and programs. It leaves entirely for state control any questions for groundwater supply, and it envisions the adoption of a classification or zoning scheme for groundwater. The draft is considered here as a convenient vehicle for discussion of issues on the development of a wise groundwater policy. The flaws in the proposal are examined and the body of statutory authority which is available to the EPA for the protection of groundwater but which the agency seems remiss to employ is reviewed. The proper roles of federal and state governments are considered along with an alternate strategy more likely to meet the stated goal. It is argued that only an unwavering commitment to the protection of the nation's groundwater supplies, reflected in a consistent and comprehensive federal policy, will forestall the serious threat currently facing our supply of drinking and irrigation water. (Baker-IVI)
W84-04533

THE DILEMMA OF THE DOWNSTREAM STATE: THE UNTIMELY DEMISE OF FEDERAL COMMON LAW NUISANCE,
M. Collins.

Boston College Environmental Affairs Law Review, Vol. 11, No. 2, p 295-412, 1984. 522 Ref.

Descriptors: *Common law, *Nuisance, *Lake Michigan, *Wisconsin, *Milwaukee, *Illinois, Supreme Court, Clean Water Act, State jurisdiction, Federal jurisdiction, Water pollution control, Wastewater disposal.

A controversy arose between the City of Milwaukee and Illinois when the state attempted to protect its interests in Lake Michigan as a source of drinking water and great recreational and aesthetic value. Illinois' complaint focused on two categories of discharges from Milwaukee: municipal sewage treatment plant discharges and sewer overflows. The application of the Clean Water Act to the problem is detailed. The Supreme Court decision which was reached eventually set forth a broad foundation for the displacement of federal common law nuisance by environmental statutes in general. In light of the broad language of the Supreme Court's opinions and the Court's underlying approach to legislative intent in the case it appears that virtually any legislative scheme which regulates a given area requires the preemption of federal common law. The Court's legislative inquiry does not directly support the conclusion that Congress intended that pollution control standards under the NPDES program be the exclusive means to abate pollution hazards. A closer look at the decision reveals that the factors supporting the Court's decision all relate to the legislative delegation of authority to a specialized expert agency, the EPA, charged with policing dischargers and thoroughly regulating discharges through a permit program. Primary efforts to control and prevent enviromental pollution have been and must continue to be statutory. (Baker-IVI)
W84-04534

LEGAL ASPECTS OF DAM SAFETY,
Western New England Coll., Springfield, MA. School of Law.
D. Binder.
International Water Power and Dam Construction, Vol. 36, No. 4, p 24-26, April, 1984. 14 Ref.

Descriptors: *Dam failure, *Legal aspects, Liability, Public rights, Dam construction, Safety, Negligence, Flood damage, Flash floods.

The approach to dam liability in the United States varies from state to state throughout the country. In addition, the approach to dam failure may not always be consistent with the response to failures of other civil structures. The three most common theories of relief for the victims of a dam failure are negligence, strict liability, and, to a lesser degree, violation of statutes. Occasionally a state will have a statute which imposes strict liability in dam failures. Liability has also occasionally been imposed on a theory of trespass, whereby the defendant has caused water to overflow on another's land. In general, a plaintiff cannot recover if the damage would have occurred in spite of the dam's existence. Such a result can occur when a storm is of such intensity that the plaintiff would have been washed away regardless of a dam's safety. There is no legal liability because there is no causation in fact. With respect to flash floods, the rule which has evolved is that the flood must be so extraordinary that the reasonably prudent person could not have anticipated it. To use the Act of God defence certain requirements must usually be met: unforeseeability by reasonable human intelligence and the absence of a human agency causing the alleged damage. Thus, if a similar storm had occurred before, or could be anticipated using modern techniques, or if the storm or damage were otherwise reasonably foreseeable, even if not probably, the Act of God will not serve as a defence. (Baker-IVI)
W84-04665

6G. Ecologic Impact Of Water Development

POPULATION BIOLOGY IN THE COURTROOM: THE HUDSON RIVER CONTROVERSY,
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5C.
W83-04283

VALUE OF PRAIRIE WETLANDS TO DUCK BROODS,
Fish and Wildlife Service, Jamestown, ND. Northern Prairie Wildlife Research Center.
H. F. Duebbert, and A. M. Frank.
Wildlife Society Bulletin, Vol. 12, No. 1, p 27-34, Spring, 1984. 2 Fig, 5 Tab, 16 Ref.

Descriptors: *Wetlands, *Ducks, *Wildlife management, *Prairies, *North Dakota, *South Dakota, Wildlife conservation.

A total of 4370 duck broods were observed in the prairie pothole region of North and South Dakota during 1958-1978. Dabbling duck broods made up 83% of the total, with blue-winged teal, gadwall, and mallard being the top 3 species. Fifty-eight percent of the broods were observed on semipermanent wetlands and 24% on seasonal wetlands. Brood size was reduced by about 2 ducklings between hatch and Class I. The data did not indicate a serious loss of ducklings after three broods reached water. For early-nesting species (mallard and pintail), 84 and 90% of the broods hatched by 7 July. For gadwall, blue-winged teal, and northern shoveler (later nesters), 87, 90 and 94% of broods hatched by 21 July. Preservation and management of seasonal wetlands should be given greater consideration based on these findings. (Baker-IVI)
W84-04192

HEAT TRANSFER; ENVIRONMENTAL ASPECTS,
Notre Dame Univ., IN. Dept. of Aerospace and Mechanical Engineering.
For primary bibliographic entry see Field 5B.
W84-04199

A FISH POPULATION MODEL FOR INSTREAM FLOW ASSESSMENT,
Pennsylvania State Univ., University Park. Dept. of Biology.
F. M. Williams.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-159680, Price codes: A03 in paper copy, A01 in microfiche. Pennsylvania Institute for Research on Land and Water Resources, University Park, Completion Report (LW8401), January, 1984. 41 p, 16 Fig, 1 Tab, 12 Ref, 2 Append. Project No. OWRT A-059-PA(1), Contract/Grant No. 14-34-0001-2140.

Descriptors: *Fish populations, *Instream flow, *Weighted usable area, Consumptive loss, Smallmouth bass, Electivity curves, Hydraulic model, Fishery habitat.

An age structured fish population model has been proposed that is responsive to flow variations that create changes in the density dependent factor, available habitat. The model was implemented for a smallmouth bass population. Simulation results, shown to be robust with respect to environmental input values and internal paramter values, indicate that flow variations have a profound effect on the magnitude and variability of early life history stages, but the adult spawning population shows extreme stability with respect to these perturbations. This may provide some insight into life history strategies in a variable environment.
W84-04238

PRELIMINARY APPRAISAL OF THE HYDROLOGY OF THE STIGLER AREA, HASKELL COUNTY, OKLAHOMA,
Geological Survey, Oklahoma City, OK. Water Resources Div.
For primary bibliographic entry see Field 2A.
W84-04267

AGRICULTURAL DEMAND FOR WATER IN LOWLAND AREAS,
For primary bibliographic entry see Field 3F.
W84-04314

BRACHYCENTRUS AMERICANUS AND B. OCCIDENTALIS (TRICHOPTERA) IN A REGULATED STREAM,
Brigham Young Univ., Provo, UT. Dept. of Zoology.
R. N. Winget.
Journal of Freshwater Ecology, Vol. 2, No. 4, p 373-381, April, 1984. 3 Fig, 2 Tab, 15 Ref.

Descriptors: *Environmental effects, *Dam construction, Streams, Seasonal variation, Huntington Canyon, Wasatch Plateau, Electric Lake, Macroinvertebrates.

Late instar Brachycentrus americanus larvae were collected just prior to and during normally high spring runoff. Adults were collected immediately following runoff and early instar larvae appeared during the late summer low flow period of September and October. Bicarbonate alkalinity concentrations averaged approximately 150-200 mg/l during the study with little change following impoundment of Huntington River. The pH of Huntington River waters before the dam generally ranged from 7.5 to 8.8 with lower values during winter/spring and higher values during summer/fall. Average pH was 8.1 above the lake, 7.45 at dam outfall, and 7.8 at Station D-4, located two km below Electric Lake Dam. Before the dam, temperature changes in the water in Huntington River were 18-20 degrees C, but after dam completion the temperature range was only 4-5 degrees C. Both B. americanus and B. occidentalis were stressed at Station D-4. It appears that with July to August flushes, summer hatching of B. occidentalis may be a disadvantage in Huntington River. Early spring emergence of B. occidentalis appears to have some advantage during above normal early spring runoff occurrences. Late summer hatching of B. americanus appears to be the more advantageous under the regulated flow regime of Huntington River. (Baker-IVI)
W84-04385

EFFECTS OF MULTIPHASE RESTORATION, PARTICULARLY ALUMINUM SULFATE APPLICATION, ON THE ZOOPLANKTON COMMUNITY OF A EUTROPHIC LAKE IN EASTERN WASHINGTON,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
M. V. Gibbons, F. D. Woodwick, W. H. Funk, and H. L. Gibbons.
Journal of Freshwater Ecology, Vol. 2, No. 4, p 393-404, April, 1984. 3 Fig, 16 Ref.

Descriptors: *Zooplankton, *Lake restoration, Lakes, Eutrophication, Washington, Aluminum sulfate, Sulfates, Liberty Lake.

Zooplankton populations of Liberty Lake, Washington were investigated over a span of four years to determine the short-term effects of a series of multiphase lake restoration measures on lake zooplankton. Liberty Lake is a moderately sized, soft water lake of glacial origin. The lake is a weakly buffered system with the entire volume of 20100000 cubic meters essentially euphotic throughout the year. Thirty-nine species of zooplankton were identified during the study period. In response to restoration treatments, the zooplankton community exhibited some short term population fluctuations. Suction dredging had no apparent effect upon the zooplankton in the lake. The gross effects of aluminum sulfate applications were also minimal. A sharp decline in numbers was noted in all major groups immediately following each alum application, but recovery was evident in the maintenance of typical seasonal growth patterns. The Eucopepoda exhibited rapid recovery following both alum treatments, responding most

favorably to the short term oligotrophic-like conditions apparently created by the treatments. Similarities in zooplankton response to the alum application and to the May 1980 Mt. St. Helens ashfall are briefly discussed. (Baker-IVI)
W84-04386

THE FLOODING OF JAMES BAY,
S. McCutcheon.
New Scientist, Vol. 1011, No. 1402, p 35-41, 22 March, 1984. 5 Fig.

Descriptors: *Water resources development, *Environmental effects, *James Bay, *Quebec, Hydroelectric plants, Earthquakes, Flooding, Cree Indians, Indian rights.

During the past 10 years, James Bay in Canada has become the scene of a massive hydroelectric powerplant development. While the plan was devised to make use of the wilderness areas, little consideration was originally given to the Cree Indians who lived in this region and depended on its natural conditions for their needs. Opponents to the scheme forecasted vast disturbances of nature suggesting earthquakes and climatic changes. In order to keep track of the changes brought about to the environment by the project, extensive record keeping was started of the flora and fauna in the area. Many of the activities of the construction crews were supervised so that damage to the environment during the construction phase would be kept to a minimum. The Cree Indians united and became politically active for the first time, using the judicial system to attempt to stop work. Finally they did achieve native land reserves and exclusive hunting, fishing and trapping rights incomes for hunters and trappers who spend more than half the year in the bush; a voice in approving or rejecting, on the basis of environmental impact, developments in the region; a voice in the use of funds set aside to correct damage already done to the environment; and a compensation of $225 million. Today it is clear that the devastations foretold did not happen. The region is coping extremely well with the changes man has brought to it. The attention paid to taking care of the environment certainly had a great part to play in the successful completion of the task. (Baker-IVI)
W84-04397

ECONOMICS OF PRAIRIE WETLAND DRAINAGE,
North Dakota State Univ., Fargo. Dept. of Agricultural Economics.
J. A. Leitch.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 5, p 1465-1475, September-October, 1983. 9 Fig, 3 Tab, 19 Ref.

Descriptors: *Wetlands, *Drainage, *Minnesota, *Economic feasibility, Prairies, Surface drainage, Tile drainage, Economic aspects, Farms, Nuisance.

Surface ditch and subsurface tile drainage of scattered prairie wetlands in west central Minnesota and general field drainage in south central Minnesota are representative of contemporary prairie wetland drainage. Data from a 1981 survey of farm operators regarding on-farm drainage are used to: estimate the costs of constructing wetland drains, estimate the returns from wetland drainage, and most importantly, examine the economic feasibility of on-farm wetland drainage. All of the drained wetlands are generally profitable. Where they were not profitable, they may have been feasible in terms of overall efficient field operations. Social values of wetland benefits may be larger than individual agricultural returns on drained wetlands, but until social values can be reliably estimated, there is no yardstick to determine what to pay to preserve wetlands. Outright prohibition of drainage is not politically feasible in rural areas. Most existing preservation programs base payments on net returns to drainage or cash rent for similar cropland. This ignores the nuisance factor and may be a prime reason for lack of participation. (Moore-IVI)
W84-04474

INTRODUCTION TO THE DELTA CASE STUDIES,
Rijkswaterstaat-Deltadienst, Rijswijk (Netherlands).
M. Knoester.
Water Science and Technology, Vol. 16, No. 1/2, p 1-9, 1984. 6 Fig, 7 Ref.

Descriptors: *Environmental effects, *Flood control, *Netherlands, *Dutch Delta Region, Estuarine environment, Basins, Shellfish, Barriers.

In 1953 a disastrous storm flood hit the Dutch Delta Region. Since that time an extensive program for safe guarding this area has been carried out. An essential part of that plan is the establishment of a new primary defence against storm floods in the form of water barriers built between the islands. The basins in between, formerly estuarine systems, are each affected in a different way. The coincidence of the interests of both the fishing industry and nature conservation eventually led in 1976 to a radical modification of the Delta Project, aimed at ensuring both the safety of the region and the retention of the tidal environment in the Eastern Scheldt. Three case studies, each concerned with a particular stretch of the estuary, have been conducted. The Hollandsch Diep and the Haringvliet formed the main outflow channel of the Rhine and the Meuse. These were transformed in 1970 from a tidal river estuary into a freshwater lake with irregular changes in water level. The hydraulic-engineering work carried out in this area has been executed in accordance with the original Delta Plan. Lake Grevelingen originally was an arm of the sea. After closure, the Grevelingen was in the process of becoming a stretch of brackish water and it is now managed as a stagnant saltwater lake. There is no other similar ecosystem in the region. The work here has gone according to the original plan but the process of decision-making regarding the Eastern Scheldt has left open a new possibility of choosing between fresh water and salt water. The Eastern Scheldt where the Delta works are still in the execution stage, has received the greatest impact from fishing and naturalist interests. The plan for this area is characterized by the objective of maximizing the extent of the transformation to no more than a reduction in the tidal range, and great care is being taken in the planning process for this region. (Baker-IVI)
W84-04493

THE HARINGVLIET-PROJECT: THE DEVELOPMENT OF THE RHINE-MEUSE ESTUARY FROM TIDAL INLET TO STAGNANT FRESHWATER LAKE,
Rijksinstituut voor Natuurbeheer, Leersum (Netherlands).
H. A. Ferguson, and W. J. Wolff.
Water Science and Technology, Vol. 16, No. 1/2, p 11-26, 1984. 7 Fig, 14 Ref.

Descriptors: *Environmental effects, *Flood control, *Haringvliet Project, *Netherlands, *Rhine-Meuse Estuary, Estuarine environment, Deltas, Barriers, Planning, Coastal engineering, Coastal waters.

In 1970 the common outlet of the Rhine and Meuse Rivers, the Haringvliet estuary, was closed by the construction of large sluices and changed thereby from a brackish tidal inlet into a stagnant freshwater lake. Ecological knowledge of the effects was available, but at that time hardly used in the design and execution of the large project. Part of the negative effects could have been avoided by timely integration of ecological knowledge in the realm of coastal engineering and by physical planning of the area. The day of the closure was an environmental turning point. Salt and brackish water were not able to enter the new lake any longer and the tidal amplitude of about 1 m changed to a semi-tide, partly dependent on the operation of the sluices, of about 20 cm. Major changes included a quick ripening of the soils in all areas which became more or less permanently dry. Plant species preferring wet soils decreased in favor of dry soil species. Phytoplankton numbers increased after closure, probably due to a combination of increased freshwater residence time, reduced current speeds and decreased turbidity. The brackish water copepod Eurytemora affinis disappeared completely, but the cladocerans Daphnia longispina and Bosmina longirostris as well as certain rotifers were able to take over. Bird fauna changes were also noted. (Baker-IVI)
W84-04494

GREVELINGEN: FROM AN ESTUARY TO A SALINE LAKE,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
P. H. Nienhuis, and J. C. Huis in 't Veld.
Water Science and Technology, Vol. 16, No. 1/2, p 27-50, 1984. 22 Fig, 3 Tab, 9 Ref.

Descriptors: *Environmental effects, *Estuarine environment, *Netherlands, *Grevelingen Lake, *Grevelingen, Flood control, Deltas, Barriers, Estuary, Coastal engineering, Coastal waters, Saline waters, Ecosystems.

A number of coastal engineering and ecological considerations are given concerning the changes which have occurred as a result of turning Grevelingen estuary into saline Lake Grevelingen. New hydraulic methods were used to close the 5-7 km wide estuary at both ends. The eastern secondary dam was closed in 1964 by a combination of tight caissons and rubble-stone from a cable-way. While the loss of estuarine habitats and communities on a world scale can only partly be compensated, it is stressed that Lake Grevelingen represents a rare phenomenon among the coastal and brackish inland water bodies in Europe. The water quality is very good; nutrient loading is low. The 30 sq km eelgrass vegetation, providing food and shelter to numerous animals, is a specific community, being rare along the southern North Sea. Hard substrates of sea walls and rip-rap dams harbor a diversified community rich in biota. The benthic fauna is diversified and abundant. The fish fauna is interesting both in species number and in abundance. Large numbers of birds are found on and around the lake. The vegetation in the transition area between the saline open water and the plant growth bound to fresh water on dry land shows a valuable gradient. (Baker-IVI)
W84-04495

THE EASTERN SCHELDT PROJECT,
Ministry of Transport and Public Works, Middelburg (Netherlands). Environmental Research Div.
M. Knoester, J. Visser, B. A. Bannink, C. J. Colijn, and W. P. A. Broeders.
Water Science and Technology, Vol. 16, No. 1/2, p 51-77, 1984. 12 Fig, 1 Tab, 14 Ref.

Descriptors: *Flood control, *Environmental effects, *Barriers, *Netherlands, Estuarine environment, Eastern Scheldt Project, Storms, Ecosystems, Water quality, Estuaries.

The Eastern Scheldt was the largest and therefore last tidal basin to be fully closed in the re-structuring of the Delta-works in Southwestern Netherlands as part of a flood protection plan. In former times the Eastern Scheldt was part of the multiple branched estuary of the rivers Rhine, Meuse and Scheldt. The largest structure in the Delta Project, the storm surge barrier, is being built at the mouth of the Eastern Scheldt. In the eastern part of the area two compartment dams with shipping locks are currently under construction. As a consequence of the construction of the compartment dams the present tidal area will be divided into two parts: the Eastern Scheldt, where tidal movements will be reduced by the barrier; and a freshwater lake system east of the dams. Currently research is being conducted to determine the various effects these changes have brought in the ecosystems of the area. Specific areas of study are concerned with the morphology of the channels and flats, the basic food chain, the organic communities, and the salt-marsh ecosystem. With the completion of the coastal engineering project in this region the environment there will continue to change and develop and will, for a variety of reasons, rightly continue to attract the attention of the scientific community. (Baker-IVI)
W84-04496

THE EFFECT OF COASTAL ENGINEERING PROJECTS ON MICROGRADIENTS AND MINERALIZATION REACTIONS IN SEDIMENTS,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
H. J. Lindeboom, and A. J. J. Sandee.
Water Science and Technology, Vol. 16, No. 1/2, p 87-94, 1984. 5 Fig, 1 Tab, 12 Ref.

Descriptors: *Coastal engineering, *Environmental effects, *Mineralization, *Netherlands, *Lake Grevelingen, Coastal waters, Microelectrodes, Marine sediments, Anaerobic conditions, Aerobic conditions, Dam effects, Oxygen, Sulfides.

Mineralization reactions can take place in sediments along different aerobic and anaerobic pathways. The recent introduction of microelectrodes for ecological research has enabled the determination of oxygen and sulfide gradients in situ in the sediment. These microgradients give insight into the actual mineralization reactions taking place, and changes in these reactions can now be rapidly recorded. The use of microelectrodes in the field in Lake Grevelingen is described. The effects of dam building on oxygen and sulfide microgradients and on mineralization reactions is discussed. Although there were no data obtained before the closure was made, a comparison of the open Oosterschelde estuary with the present situation in Lake Grevelingen indicates that after closure, the microprofiles and the mineralization pattern in the lake sediment changed due to the decreased current velocities and an increased organic carbon load. The introduction of microelectrodes for ecological research has enabled a detailed study of in situ microgradients in undisturbed sediments, increasing knowledge about reactions and interaction taking place. A detailed study of the effect of coastal engineering projects on the biological reactions in the sediment is now within reach. (Baker-IVI)
W84-04497

ENVIRONMENTAL IMPACT STATEMENT ON THE PROBLEM OF A FRESH OR SALT LAKE GREVELINGEN,
Ministry of Transport and Public Works, Middelburg (Netherlands). Environmental Research Div.
J. H. M. v.d. Meulen, J. Leentvaar, and N. M. de Rooy.
Water Science and Technology, Vol. 16, No. 1/2, p 107-120, 1984. 9 Fig, 3 Tab, 16 Ref.

Descriptors: *Environmental impact statement, *Lakes, Netherlands, Lake Grevelingen, Saline water, Systems analysis, Eutrophication, Toxicity, Carbon, Water quality control.

An Environmental Impact Statement has to be prepared concerning whether Lake Grevelingen will remain a salt-water basin or become a fresh-water basin in the near future. The system analysis approach is used to obtain the information needed for such a determination and an outline is provided of the quality of the salt-water and the fresh-water Lake Grevelingen. This approach was useful in dividing the study into coherent parts and assigning the tasks to different work groups. The only problem with this division approach was that each group tended to set criteria for an ideal water basin rather than for the basin at hand. The studies indicated that the prediction of the eutrophic level was of crucial importance for the appraisal of the lake. With respect to the prediction of the eutrophication of the fresh-water lake a number of assumptions are needed, however the results are in accordance with observations made in equivalent Dutch lakes. A possible compromise between the desire of the agricultural community on the isle Schouwen-Duiveland for fresh-water for irrigation of the fields and the desire of the groups for nature conservation, recreation and fisheries would be a salt-water Lake Grevelingen with a supply of fresh-water through a pipeline from Lake Volkerak. (Baker-IVI)
W84-04498

THE TECHNICAL AND ECONOMIC ASPECTS OF THE WATER SEPARATION SYSTEM OF THE KRAMMER LOCKS,
Rijkswaterstaat-Deltadienst, The Hague (Netherlands).
J. G. Hillen, C. P. Ockhuysen, and P. v.d. Kuur.
Water Science and Technology, Vol. 16, No. 1/2, p 131-140, 1984. 12 Fig, 1 Tab, 1 Ref.

Descriptors: *Locks, *Saltwater intrusion, Gates, Navigation, Mixing, Seawater, Saline water, Model studies, Pumping plants, Netherlands, Krammer Locks.

Technical and hydraulic aspects of the water separation system of the Krammer Locks in the Netherlands are discussed. Attention is paid to the impact on the environment, to the energy consumption of the pumping station and the consequences for inland water transport. The effect of different ways to operate these locks is shown. It is estimated that the Krammer Locks will bear a volume of 60 million tons of traffic in dead weight in 1987 and that this figure will reach 80 million tons in the year 2000. The water separation system at the locks makes use of the fact that saltwater is heavier than freshwater. When the vessel has entered the lock and both gates have been closed, the saltwater is drained from the lock chamber through a perforated floor. The freshwater is supplied by 114 wall culverts which are highly positioned along the entire length of the 2 chamber walls. The degree of mixing of salt and fresh water is discussed. (Baker-IVI)
W84-04500

RESPONSE OF MACROZOOBENTHOS TO A TEMPORAL LOWERING OF CHLORINITY: A LARGE-SCALE FIELD EXPERIMENT IN THE DUTCH DELTA AREA,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
J. Coosen, and R. J. Leewis.
Water Science and Technology, Vol. 16, No. 1/2, p 141-150, 1984. 4 Fig, 2 Tab, 20 Ref.

Descriptors: *Environmental effects, *Benthos, Netherlands, Deltas, Seasonal variation, Estuaries, Saline water, Volkerak sluices, Intertidal areas, Keeten-Krammer-Volkerak.

The chlorinity in the Keeten-Krammer-Volkerak area was considerably lowered during the winter of 1979/1980 due to an experimental doubling of the freshwater discharge at the Volkerak sluices. Species composition, abundance and biomass of the intertidal macrozoobenthos was studied prior to 1978, 1979 and after 1980, 1981 in order to assess the possible impact of this change in chlorinity. While species that had been abundant before the experiment were still abundant afterwards, nevertheless, species number directly after the experiment was lower than before. Some of the relatively rare species were not found immediately following the experiment but did return later. The Shannon-Weaver diversity index did not show a significant change. Sample classification using the Bray-Curtis dissimilarity index, indicated that most pre-experimental samples were similar to post-experimental samples. Dissimilarity was found between March and October samples. The water quality remained good. (Baker-IVI)
W84-04501

NAKANOUMI LAND RECLAMATION AND FRESHENING PROJECT,
Tokyo Univ. (Japan). Inst. of Applied Microbiology.
H. Ohtake.
Water Science and Technology, Vol. 16, No. 1/2, p 151-170, 1984. 9 Fig, 2 Tab, 15 Ref.

Descriptors: *Environmental effects, *Land reclamation, Japan, Lakes, Lake Nakanoumi, Environmental impact statement, Lagoons, Coastal waters, Ecosystems, Sea of Japan.

Lake Nakanoumi is a shallow coastal lagoon connected with the Sea of Japan only by a narrow channel. The Nakanoumi Land Reclamation and Freshening Project began in 1963 with the objectives being to reclaim agricultural lands of 25 sq km from the lake and to convert the remaining water basin into a fresh water reservoir by damming its narrow entrance. Work on the project has lasted 15 years, and the natural environment of Lakes Nakanoumi and Shinji has been damaged by a variety of human activities connected with the project. Reclaimed lands are an intrusion on the natural landscape and construction works are harming the nesting ground for waders. There is a fear that the expected reservoir will be heavily damaged by the eutrophication. (Baker-IVI)
W84-04502

ECOLOGY AND THE ZUIDERZEEPROJECT,
Rijksdienst voor de Ijsselmeerpolders, Lelystad (Netherlands).
J. de Long, and J. H. Roelofs.
Water Science and Technology, Vol. 16, No. 1/2, p 171-206, 1984. 23 Fig, 2 Tab, 33 Ref.

Descriptors: *Environmental effects, *Planning, *Land reclamation, Water management, Netherlands, Zuiderzee, Estuarine environment, Zuiderzeeproject, Decision making.

Execution of the Zuiderzeeproject has brought with it large changes in this large estuarine area of over 500,000 ha. The area has been dammed and its waters changed into stagnant, eutrophic freshwaters by using the water from the river IJssel. The execution of the project over the past 60 years has indicated that it is necessary to strive as far as possible when planning and designing a new area of land toward an integrated approach including social, economic, ecological, technical, asthetic and other factors which are involved. Bringing the planners and researchers together in a very limited number of oganizations contributes highly to the quality of the work and decreases the risk of competition between many companies and simply too many different people having a part in management decisions. As much as possible, plans should be flexible to meet needs determined by ongoing studies. Finally, ecologists need to learn to integrate their scientific knowledge into the many other aspects involved in the execution of a large work. (Baker-IVI)
W84-04503

THE NAKDONG ESTUARY BARRAGE AND LAND RECLAMATION PROJECT,
Industrial Sites and Water Resources Development Corp., Seoul (Korea).
K. K. Ho, and G. van Houweninge.
Water Science and Technology, Vol. 16, No. 1/2, p 207-222, 1984. 7 Fig, 5 Ref.

Descriptors: *Land reclamation, *Water resources development, Estuaries, Estuarine environment, Environmental effects, Nakdong Estuary, Saline water intrusion, Encroachment, Locks, Water quality.

As a result of the increasing industrial, municipal and agricultural water demand in the Nakdong River Basin, the available amount of fresh river water to repulse salinity intrusion into the lower reaches of the river rapidly decreases during the dry season. The interaction between barrage construction and the estuary and river environment was examined as attempts are made to ensure a reasonable supply of fresh water to the city of Busan. The study comprised ecological, water quality and morphological aspects. The results were incorporated into the technical design and proposed management of the barrage, so that it could meet its major objective, the avoidance of salinity intrusion into the reservoir during operation under low flow conditions, and have the minimum effect on the surrounding environment. The barrage is also to maintain a sufficient low salinity level near the Sasang summerbed agricultural area. Full opening of the barrage over the whole tidal cycle is not advised during river discharges lower than 700 cubic m/second. Full opening of the barrage should take place for river discharges over 1,000 cubic m/second to avoid an increase of the flooding frequency of the summerbed agricultural area. Flushing of the reservoir is advised if required to maintain a proper water quality. (Baker-IVI)
W84-04504

NAKDONG ESTUARY BARRAGE AND LAND RECLAMATION - ECOLOGICAL ASPECTS,
Euroconsult, Arnhem (Netherlands).
J. C. Post.
Water Science and Technology, Vol. 16, No. 1/2, p 223-231, 1984. 4 Fig, 9 Ref.

Descriptors: *Land reclamation, *Environmental effects, Nakdong Estuary, Estuarine environment, Estuaries, Birds, Environment impact statement, Decision making.

In Korea, construction of a barrage in the mouth of the Nakdong river is planned. The barrage will be situated in a nature reserve, designated as a wintering ground for migratory birds. Construction of the barrage and the associated land reclamation area will have a negative impact on the bird population. Alternative designs and locations for the barrage and land reclamation sites have been made in order to minimize the ecological impact of the project. A compromise has been made between technical requirements and ecological desirabilities. An ecological research and management program has been drafted as a part of the barrage project. While the originally proposed site has been the one finally chosen, based on technical and economic grounds, the design has undergone changes. A discharge sluice will be constructed in the right river branch, which will enable the fresh water distribution in the estuary to be manipulated to some extent. The loss of tidal flats due to dredging will be reduced and the alteration of the original channel system minimized as much as possible. The southern tip of Eulsuk island, which will be closed from the rest of the island, could then be developed into a bird sanctuary. (Baker-IVI)
W84-04505

NAKDONG ESTUARY BARRAGE AND LAND RECLAMATION - MORPHOLOGICAL ASPECTS,
Waterloopkundig Lab., Delft (Netherlands).
W. D. Eysink.
Water Science and Technology, Vol. 16, No. 1/2, p 233-241, 1984. 4 Fig, 3 Tab, 6 Ref.

Descriptors: *Environmental effects, *Land reclamation, Estuarine environment, Estuaries, Nakdong Estuary, Siltation, Reservoirs, Dredging, Tidal flats, Saline water intrusion.

The Nakdong Estuary barrage and land reclamation project will prevent the present water losses for salt repulsion and create a small fresh water reservoir and new land for agriculture and industrial development of the Busan area. Of the various morphological consequences of the project, the most relevant will be the impacts on the remaining tidal reach and the tidal flat region. The silting of the reservoir will develop very gradually and should be counter balanced by regular maintenance dredging to avoid unacceptable extreme water levels upriver. The negative impact on the tidal flat area is temporary when no or only a modest maintenance dredging in the downstream discharge channels is applied and is the lowest with the barrage at Hadan. Full maintenance dredging to preserve the present main channel dimensions in the tidal reach would be expensive and increase the negative impact on the tidal flats and the barrier islands. A compromise could be found with the barrage at Hadan, causing acceptable extreme water levels upriver and requiring a reduced maintenance dredging in only a part of the downstream discharge channels which will induce no further adverse effects on the area of the tidal flats. (Baker-IVI)
W84-04506

WATER QUALITY ASPECTS OF THE NAKDONG ESTUARY BARRAGE,
DHV Consulting Engineers, Amersfoort (Netherlands).
J. W. van Sluis, and L. Lijklema.
Water Science and Technology, Vol. 16, No. 1/2, p 243-252, 1984. 5 Fig, 2 Tab, 7 Ref.

Descriptors: *Environmental effects, *Water resources development, Nakdong Estuary, Construction, Decision making, Estuarine environment, Estuaries, Water quality, Algal growth, Wastewater disposal, Mathematical studies.

The construction of the Nakdong Estuary Barrage will completely change the hydrological situation in the mouth of the Nakdong river. The size of the estuary will be considerably reduced. A large reservoir is to be created upstream of the barrage. Main points of interest are the effects of the discharge of raw sewage and treated effluent into the Nakdong river on the water quality in the projected reservoir and the water quality forecasts for the remaining part of the estuary, in relation with the existing plans for sewerage and sewage treatment for the city of Busan. Measures to reduce the effects of the barrage and the outline of a water quality management program are presented. Special consideration is given to the methodological aspects of the water quality study. The studies underline the importance of carrying out preliminary design and environmental analysis simultaneously. Mathematical (water) quality models used in design studies should be selected in accordance with the quantity and reliability of the available data and should be concentrated on major processes and effects. (Baker-IVI)
W84-04507

TIDAL POWER FROM THE SEVERN ESTUARY,
J. Corlett.
Water Science and Technology, Vol. 16, No. 1/2, p 253-268, 1984. 5 Fig, 14 Ref.

Descriptors: *Environmental effects, *Water resources development, Planning, Decision making, Water quality, Severn Estuary, Estuarine environment, Estuaries, Construction, Energy, Tidal powerplants.

After many years of public discussion, the British government set up the Severn Barrage Committee in 1978 to advise the Secretary of State for Energy on whether to proceed with a scheme for harnessing the tidal power of the Severn Estuary for the production of electricity. Among the 23 members of the the committee, two were ecologists. Many studies were commissioned on engineering, economic, social and environmental aspects of the proposed schemes and 27 of the 106 major reports submitted to it concerned ecology, nature conservation and water quality. The reports included predictions of what might happen in the estuary if a barrage were to be built. Many reports say that the amount of data available is limited and suggest further work that needs to be done. While building the barrage has been judged to be technically feasible, the economic viability depends on the relative costs of electricity generation to other methods of obtaining energy such as nuclear power. (Baker-IVI)
W84-04508

ENVIRONMENTAL AND NATURE CONSERVATION ASPECTS OF TIDAL POWER PROPOSALS FOR THE SEVERN ESTUARY (UK),
Nature Conservancy Council, London (England).
R. Mitchell, and P. K. Probert.
Water Science and Technology, Vol. 16, No. 1/2, p 269-279, 1984. 23 Ref.

Descriptors: *Environmental effects, *Water resouces development, Tidal estuaries, Estuarine environment, Estuaries, Energy, Powerplants, Environmental impact statement, Construction.

Recent studies of tidal power generation in the Severn Estuary indicate that a single basin ebb-generation scheme would produce marked changes in the physical and chemical environment. The impact of these factors on the natural environment is reviewed. Implications for the particular features of nature conservation interest of this important estuarine area are examined and the opportunities for the amelioration of deleterious effects are discussed. The most obvious effect of a tidal barrage would be the changes in water level. Changes in water flow patterns are also examined along with sediment transport, deposition and erosion patterns. Primary productivity is discussed including zooplankton, and benthos. Waders and wildfowl, migratory fish, and marine fish were also considered. Amelioration of adverse effects is discussed. (Baker-IVI)
W84-04509

INTEGRATION OF ECOLOGICAL AND ENGINEERING ASPECTS IN PLANNING LARGE SCALE TIDAL POWER DEVELOPMENT IN THE BAY OF FUNDY, CANADA,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
D. C. Gordon, Jr.
Water Science and Technology, Vol. 16, No. 1/2, p 281-295, 1984. 3 Fig, 1 Tab, 16 Ref.

Descriptors: *Environmental effects, *Water resources development, *Tidal powerplants, Energy, Bay of Fundy, Canada, Tidal waters, Decision making.

Large-scale tidal power development in the Bay of Fundy has been given serious consideration for over 60 years. Tides in this bay are among the highest in the world. The mean tidal range is 10-12 cm and can exceed 16 m at certain times and places. Interaction between engineers and environmental scientists that has taken place over the years is reviewed. A proposed layout of a tidal power project at the mouth of Cobequid Bay is presented along with a hypothetical construction schedule for the project. The final guidelines will be transmitted to the tidal project proponent who will use them to help design impact assessment studies. These studies are short-term applied investigations which focus on specific environmental questions that must be answered. There is a need to establish a multidisciplinary research group, funded by the proponent, to conduct long term research to determine the actual environmental changes that occur, thereby testing the predictions made during the environmental impact assessment exercise. (Baker-IVI)
W84-04510

ENVIRONMENTAL CONSEQUENCES AND AMELIORATIVE MEASURES OF THE ANNAPOLIS TIDAL POWER PROJECT,
Acadia Univ., Wolfville (Nova Scotia). Dept. of Biology.
G. R. Daborn, G. C. Baker, and M. J. Dadswell.
Water Science and Technology, Vol. 16, No. 1/2, p 297-306, 1984. 4 Fig, 8 Ref.

Descriptors: *Environmental effects, *Tidal powerplants, Water resources development, Annapolis Estuary, Estuarine environment, Fish, Environmental impact assessment, Planning, Decision making, Nova Scotia.

A 7.6 m diameter straight flow turbine was installed in an existing rockfill tidal dam at Annapolis Royal, Nova Scotia. Operation as an ebb-flow generator will yield 17.8 MW at heads of 5-6 m. Environmental consequences, and changes in design and operating mode, and remedial measures required to accommodate effects on agriculture and fish passage are outlined. The process of environmental impact assessment and integration is described and discussed. When such projects are being undertaken, it is essential that proponents draw into the planning stages environmental scientists so that those studies that need conducting can be initiated, and to provide everyone with ecological insight as may already be available, when it can do the most good. (Baker-IVI)
W84-04511

ASSESSING THE ENVIRONMENTAL IMPACT OF THE ANNAPOLIS TIDAL POWER PROJECT,
Martec Ltd., Halifax (Nova Scotia).
W. G. Tidmarsh.
Water Science and Technology, Vol. 16, No. 1/2, p 307-317, 1984. 4 Fig, 12 Ref.

Descriptors: *Tidal powerplants, *Environmental effects, Environmental impact statement, Annapolis, Water resources development, Decision making, Planning, Nova Scotia, Turbines.

An 18 MW pilot tidal power project is being developed in an existing tidal barrage on the Annapolis River Estuary in southwestern Nova Scotia to evaluate the performance of a prototype STRAFLO turbine. An environmental assessment to identify potential impacts on regional biophysical and socio-economic features was completed. The assessment indicated that the most significant potential impacts of the Annapolis Tidal Power Project will be the effect on fish passage through the barrage, and interference with drainage systems on the marshlands adjacent to the estuary. The investigation showed that measures could be taken to alleviate drainage problems and assist fish passage upstream, but the concerns associated with fish mortalities in the turbine could not be answered to the satisfaction of all concerned. (Baker-IVI)
W84-04512

ENVIRONMENTAL ASPECTS CONNECTED WITH HIGH WATER PROTECTION OF VENICE,
Istituto di Ricerca sulle Acque, Rome (Italy).
R. Passino, and A. Todisco.
Water Science and Technology, Vol. 16, No. 1/2, p 319-336, 1984. 4 Fig, 3 Tab, 13 Ref.

Descriptors: *Environmental effects, *Water resources development, Coastal waters, Venice, Lagoons, Water management, Decision making, Planning.

Engineering and environmental aspects of the project for high water protection of the lagoon of Venice are described. The lagoon is 50 km long, 12 km wide, and 0.5 m deep, on the average. Man made transformations affecting the lagoon, particularly in the last fifty years, have enhanced hydrodynamic phenomena to such an extent that, in terms of high water, there has been a considerable increase in the number of days per year in which comparatively serious flooding of the lagoon-side towns occurs. Lagoon basin expansion had only a slight effect on tidal attenuation even in the case of very high tides. The possible benefit accruing from raising the ground level in dwelling areas has been evaluated in terms of increasing the level at which submergence can occur in view of the difficulties already involved in raising the level of the pavements and the canal edges. Possible advantages of movable or fixed barriers are each considered. (Baker-IVI)
W84-04513

QUANTITATIVE HYDROPHYSICAL CRITERIA OF THE EFFICACY OF RECLAMATION OF FINE-TEXTURED SOILS,
A. M. Globus, M. Sh. Nurmagambetov, and I. A. Romanov.
Soviet Soil Science, Vol. 15, No. 1, p 121-126, 1983. 3 Fig, 1 Tab, 16 Ref. Translated from Pochvovedeniye, No. 1, p 127-131, 1982.

Descriptors: *Land reclamation, *Soil properties, Soil water, Soil water potential, Soil physical properties, Pore size.

In order to develop land reclamation practices one must have objective criteria of their effect on the water-air properties of the soil. All practices for the reclamation of fine-textured soils are ultimately directed toward favorably changing the pore-size distribution. This change is reflected in a change of the main hydrophysical characteristic (MHC) of the pores. Therefore, a study of the changes in the MHC under the effect of various amendments and their amounts is a necessary part of investigations of the hydrophysical aspects of reclamation efficacy. The effect of some amendments on the MHC of a fine-textured soil, in general, and on its critical potential, in particular were studied. The concept of the critical aeration potential of swelling soils is introduced. A method is also proposed for determining the critical aeration potential and the magnitude of its change under the effect of some amendments is established. (Baker-IVI)
W84-04520

WETLAND IMPACT ASSESSMENT: PROBLEMS UNDER THE CLEAN WATER ACT,
Nelson (R. Wayne) and Associates, Inc., Boulder, CO.
R. W. Nelson.
Environmental Impact Assessment Review, Vol. 4, No. 1, p 25-40, March, 1983. 5 Fig, 13 Ref.

Descriptors: *Wetlands, *Regulations, *Environmental impact statement, Clean Water Act, Construction, Environmental effects, Water resources development, Decision making, Management, Water management.

The thrust of current change in the wetland regulatory strategy as initiated by the Army Corps of Engineers is to concentrate the government's limited resources where they are needed most, that is, where wetlands are clearly at high risk from activities normally viewed as threatening. The more costly approach calling for separate project permits, site-specific impact assessments, and routine surveillance cannot be justified from the standpoint of cost-effectiveness where the proposed activities are relatively benign. The expanding use of general permits covering these less damaging activities may have to be tempered in several ways so the ecologically valuable wetlands can still be protected, especially from the unforeseen cumulative and compounding impacts that may result from many individually low risk activities affecting the same natural system. Better documentation is called for to support the premise that activities brought under general permits really cannot generate more than minor cumulative impacts as mandated by the EPA. Greater use of the Corps of Engineers' areawide wetland review is suggested to assess cumulative effects where many similar activities are allowed under general permits within the same natural system. Instead of depending on the wetland review to uncover suspected cumulative impacts, it is suggested that the natural areas having wetlands considered unsuitable for a discharge of dredged or fill material because of their high intrinsic ecological or public interest values be identified in advance. General permits should be issued strictly on a statewide basis, or perhaps by river basin or other natural region, so critical differences around the country are not ignored. (Baker-IVI)
W84-04612

EFFECTS OF CHANGES IN DISCHARGE LEVEL ON TEMPERATURE AND OXYGEN REGIMES IN A NEW RESERVOIR AND DOWNSTREAM,
Guelph Univ. (Ontario). School of Engineering.
G. L. Mackie, J. B. Rooke, J. C. Roff, and J. F. Gerrath.
Hydrobiologia, Vol. 101, No. 3, p 179-188, May, 1983. 6 Fig, 24 Ref.

Descriptors: *Environmental effects, *Discharge hydrographs, *Discharge measurement, *Temperature, *Oxygen balance, *Dam effects, Discharge level, Guelph Lake, Ontario, Canada.

Temperature and oxygen regimes were monitored weekly in a four-year old reservoir and downstream for ten weeks during the summer (May 15 to July 30, 1979), and monthly in the fall and winter. During the summer discharge levels were changed from top to bottom in the eighth week, back to top in the ninth, all at 0.71 cu m/s (=25 cfs), and returned to the bottom in the tenth, but at 1.14 cu m/s (= 40 cfs). Changing the discharge level had little or no impact on the thermal regime within the lake or downstream at 1.14 cu m/s and only a moderate impact on water in the lake near the dam at 0.71 cu m/s bottom discharge by generating double thermoclines. Oxygen depletion rates were greatest near the surface of the lake, mainly due to temperature effects, but increased greatly at the 3 m depth, the level of the top discharge port, when discharge was changed from bottom to top. Discharge of anoxic waters through the bottom of the dam caused a drop in oxygen content immediately downstream but oxygen content returned to inflow values within 1 km downstream of the dam. (Author's abstract)
W84-04710

INFLUENCE OF WATER LEVEL DRAWDOWN ON THE FISH POPULATIONS OF CROSS LAKE, MANITOBA,
Manitoba Dept. of Natural Resources, Winnipeg. Fisheries Branch.
M. N. Gaboury, and J. W. Patals.
Canadian Journal of Fisheries and Aquatic Science, Vol. 41, No. 1, p 118-125, January, 1984. 6 Fig, 3 Tab, 19 Ref.

Descriptors: *Drawdown, *Fish populations, *Cross Lake, *Manitoba, Aquatic habitats, Reservoir operation, Environmental effects, Winterkill, Mortality, Cisco, Pike, Whitefish, Walleye.

Regulated discharges into Cross Lake, Manitoba, resulted in average summer water volumes in 1980 and 1981 that were 40% lower than preregulated volumes. Water level drawdown in the summer reduces the amount of available habitat. Consequently, the standing crops of lake whitefish (Coregonus clupeaformis), walleye (Stizostedion vitreum vitreum), northern pike (Esox lucius), and cisco (Coregonus artedii) are lower now that in preregulation and early postregulation years. Unusually early and rapid drawdown in March 1981 resulted in a severe winterkill, causing a substantial decrease in catches per unit of effort (CPUE) for most species from 1980 to 1981. The most affected species were whitefish and cisco, which showed a 50% reduction in CPUE from 1980 to 1981. The amount of fall to lake spring drawdown and the year-class strengths of coregonid fishes were inversely related. A marked overwinter drawdown reduces whitefish and cisco hatching success apparently by dewatering their spawning areas and desiccating the eggs. Low water levels in spring prevented pike and walleye access to spawning areas. (Author's abstract)
W84-04762

7. RESOURCES DATA

7A. Network Design

COST-EFFECTIVENESS OF THE STREAM-GAGING PROGRAM IN MAINE,
Geological Survey, Augusta, ME. Water Resources Div.
For primary bibliographic entry see Field 6B.
W84-04246

7B. Data Acquisition

ULTRASONIC FLOWMETERS FOR HYDROELECTRIC PLANTS,
Westinghouse Oceanic Div., Annapolis, MD.
G. P. Erickson, and J. C. Graber, Jr.
Mechanical Engineering, Vol. 105, No. 11, p 84-88, November, 1983. 3 Fig, 1 Tab.

Descriptors: *Measuring instruments, *Flowmeters, Ultrasonics, Ultrasonic flowmeters, Powerplants, Hydroelectric plants.

Ultrasonic flowmeter systems are particularly well suited for large pipes like those common to hydroelectric plants. Ultrasonic systems cause no pressure drop, require no periodic calibration, provide continuous indications of flow and are applicable to large and small pipes. They provide an accurate and continual on-line flow measurement suitable for a variety of uses ranging from turbine acceptance testing to plant monitoring. Information is offered to assist the flow measurement user in the selection of the best ultrasonic system for the application. The factors controlling performance of an ultrasonic system are discussed with an indication of how each factor influences the results. The physical requirements are dealt with and the details that must be handled in order to optimize performance are identified. Ultrasonic flow measurement systems can cover most of the spectrum of flow measurement needs at a hydroelectric plant. An ultrasonic system employing wetted transducers can provide accurate measurement at a fraction of the cost of a Gibson test to satisfy one end of the spectrum; strap-on flow measurement systems can measure those flows where better piping configurations exist, for 4-in cooling water lines to 35-ft penstocks; wetted systems can handle more com-

plex piping configurations in pipes from 12 in. to 60 ft. (Baker-IVI)
W84-04200

CROSS-DISCIPLINE HARMONY KEEPS GROUNDWATER MONITORING EFFORTS IN TUNE.
Bendix Field Engineering Corp., Grand Junction, CO.
Water Engineering and Management, Vol. 131, No. 3, p 32-34, March, 1984. 2 Fig, 5 Ref.

Descriptors: *Groundwater, *Monitoring, *Quality control, Planning, Management, Filtration, Sample preservation, Sample collection.

Groundwater monitoring is unquestionably an interdisciplinary task. The following parameters must be met in order to ensure adequate data quality: necessary well size to accommodate sampling equipment, proper sampling method, filtration procedures and proper apparatus, sample preservation methods, choice and preparation of sample containers, procedures for field measurement, and quality assurance documentation for sample collection, field analyses and chain of custody. The drilling supervisor will determine the type of drilling equipment available to perform the task, drilling additives required, methods available to prevent downhole contamination, and borehole sampling techniques available. It is the responsibility of the hydrologist to evaluate and resolve any conflicts that may exist among the requirements of the various groups needed to perform the monitoring task. (Baker-IVI)
W84-04206

WATER MANAGEMENT,
For primary bibliographic entry see Field 5F.
W84-04413

REMOTE SENSING OF SOIL MOISTURE WITH MICROWAVE RADIOMETERS,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 2G.
W84-04436

WINTER PRECIPITATION CATCH BY HEATED TIPPING-BUCKET GAGES,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
C. L. Hanson, J. F. Zuzel, and R. P. Morris.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 5, p 1479-1480, September-October, 1983. 1 Fig, 2 Tab, 5 Ref.

Descriptors: *Rain gages, *Tipping-bucket gages, *Heated gages, *Snow, Evaporation, Thermal turbulence.

Heated-tipping bucket precipitation gages use either propane gas or electricity to heat the catchment funnel and tipping bucket mechanism so the gages can be used when the ambient air temperature is at or below freezing. Winter precipitation measured by heated tipping-bucket precipitation gages was compared to that measured by weighing-recording precipitation gages at two locations in the intermountain region of the Pacific Northwest. The heated tipping-bucket gages recorded about 30% less precipitation than the weighing-recording gages at two sites near Boise, ID and 50% less at three sites near Pendleton, OR. Probable reasons for the undercatch of these gages are: thermal turbulence transporting snow crystals away from the collector; and conditions within the collector which are favorable to evaporation of the precipitation catch. The temperature of tipping-bucket gage collectors should be maintained as low as possible to minimize the undercatch by heated tipping-bucket gages. (Moore-IVI)
W84-04476

DESIGN, INSTALLATION AND OPERATION OF A TWIN WEIGHING LYSIMETER FOR FRUIT TREES,
Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
M. J. McFarland, J. W. Worthington, and J. S. Newman.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 6, p 1717-1721, November-December, 1983. 5 Fig, 1 Tab, 18 Ref, 1 Append.

Descriptors: *Lysimeters, *Evapotranspiration, *Fruit trees, Peaches, Measurement instrumentation.

A large twin weighing lysimeter facility was installed at the Stephenville Agricultural Research and Extension Center, Stephenville, Texas, to measure evapotranspiration of mature peach trees. The system was designed to establish a check lysimeter so effects of irrigations or moisture stress or other treatment on the other lysimeter could be evaluated. Each lysimeter is a 2.44 m diameter cylinder 1.52 m deep. The weighing mechanisms for each lysimeter are three compression strain gage load cells with a sensitivity (hysteresis) of 4.54 kg. The load cell data from each lysimeter and on-site environmental data are automatically recorded on a micrologger with a sensitivity of 0.005 mg, which corresponds to a 4.45 kg weight. The equivalent depth of water for a sensitivity of 5 kg is 1 mm over the surface area of the lysimeter. (Author's abstract)
W84-04480

A COMPUTERIZED GROUND WATER MONITORING SYSTEM,
Insitu Consulting, Laramie, WY.
For primary bibliographic entry see Field 2F.
W84-04639

CONSTRAINTS AND CATEGORIES OF VADOSE ZONE MONITORING DEVICES,
Kaman Tempo, Santa Barbara, CA.
L. G. Everett, E. W. Hoylman, L. G. Wilson, and L. G. McMillion.
Ground Water Monitoring Review, Vol. 4, No. 1, p 26-32, Winter, 1984. 4 Fig, 2 Tab, 25 Ref.

Descriptors: *Monitoring, *Vadose zone, *Pollutant identification, Vadose water, Gravity groundwater, Groundwater, Monitoring, Water quality control, Soil properties.

A need to detect pollutants before they reach the water table has drawn interest to vadose (unsaturated) zone monitoring and brought together hydrogeologists, soil scientists and agricultural engineers who have been working in this area for years. The vadose zone is the geological profile from the ground surface to the upper surface of the principal water bearing strata. Recent studies have identified over 50 different types of vadose zone monitoring devices and methods that have optimum utility in varying hydrogeologic settings. In general, measurements made in the vadose zone are trying to define storage, transmission of liquid waste in terms of flux and velocity, and pollutant mobility. Criteria for the selection of alternative vadose zone monitoring methods are important for the development of site-specific systems. These criteria include: type of site; applicability to new, active, and abandoned sites; power requirements; depth limitations; multiple use capability; type of data collection system; reliability and life expectancy; degree of operational complexity; direct versus indirect methods; applicability to alternate media; effect on flow regime; and effect of hazardous waste on sampling or measurements. (Baker-IVI)
W84-04640

AN OVERVIEW OF COMPUTER TECHNOLOGY USED IN GROUND WATER FIELD STUDIES: PART I: BASICS,
Illinois State Water Survey Div., Champaign.
J. D. Ritchey, and M. A. Collins.
Ground Water Monitoring Review, Vol. 4, No. 1, p 33-38, Winter, 1984. 4 Fig, 13 Ref.

Descriptors: *Computers, *Groundwater, Automation, Data acquisition, Data processing, Field tests.

Consideration should be given to the use of computers when planning field studies. A foundation for determining the appropriate uses of computers in field studies is presented in two parts. This first part includes a brief description of the components that comprise a computer and is intended to clarify terminology and illustrate the general characteristics of these machines. Related and frequently used computer equipment is described in detail. Computer basics which are discussed include the central processing unit, central memory, bus, bulk storage, real-time clock, data acquisition equipment, communications equipment and software. (Baker-IVI)
W84-04641

NEW TAPE FOR GROUND WATER MEASUREMENTS,
Oil Recovery Systems, Needham Heights, MA.
P. J. Sanders.
Ground Water Monitoring Review, Vol. 4, No. 1, p 39-42, Winter, 1984. 3 Fig, 1 Tab, 5 Ref.

Descriptors: *Measuring instruments, *Water depth, *Groundwater, Monitoring, Tapes, Sensors.

The need to quickly and accurately monitor ground water parameters has led to the development of a new device, a composite tape which can be the link to various sensing devices. The tape consists of a standard steel engineering tape with two conductors at the edges of the tape, similar to a TV antenna wire. The tape coating is clear Tefzel, which has outstanding chemical and physical resistance. At the bottom end of the tape is a probe which can sense either water level by conductivity, a layer of organic liquid by an optical device, temperature by advanced seimconductor temperature transducers, pH, dissolved oxygen, absolute conductivity, or any other measurement that can be made with a small in situ probe. The steel tape itself provides one of three conductors and, because of its thin, flat shape, provides an excellent ground plane for electronic noise reduction. A multiplexing circuit commonly used in the electronics industry is placed inside the probe tip housing and routinely allows up to 16 signals to be transmitted to the hub at ground level. Most probes can be powered with a common 9V rechargeable battery. Signals are given either by low power-consuming light-emitting diodes or liquid crystal displays. This configuration allows for extremely accurate depth profiles of the desired parameters. (Baker-IVI)
W84-04642

SOME OBSERVATIONS ON FIELD EXPERIENCES WITH MONITOR WELLS,
Ground Water Sampling, Inc., Englewood, CA.
G. G. Hunkin, T. A. Reed, and G. N. Brand.
Ground Water Monitoring Review, Vol. 4, No. 1, p 43-45, Winter, 1984. 1 Fig, 3 Tab, 3 Ref.

Descriptors: *Wells, *Monitoring, *Groundwater, Water quality, Measuring instruments, Sampling.

The well is the basic sampling machine for the ground water industry and its ability to produce a truly representative sample underpins all data and conclusions. Regardless of the type of instrumentation used, a sample point that cannot be shown to be truly representative and that fails to provide a series of reliable samples over the long term is a negative investment. This review discusses features that have been found to be important in commercial, high-precision, water quality sampling in the western United States environments. In this area, water movement is slow and little or no exchange of water occurs between wells and the surrounding aquifer without artificial stimulation. Water quality stabilization requires multiple casing volume evacuations in wells ranging to 1,000 feet deep. High-volume pumping or mechanized bailing is an economic requirement. Any attempted improvement in utilization of data by mathematical processing or statistical treatment will be inadequate because samplings are infrequent and often accumulate at rates of only two or four sample suites per year. Powerful biases occur due to the failure of the sample point to eliminate false contributions to the

sample from sources other than the natural environment or a pollution source, most frequently originating in casing materials and annular seal leakage. (Baker-IVI)
W84-04643

COMPARISON OF ELECTRICAL RESISTIVITY METHODS FOR INVESTIGATION OF GROUND WATER CONDITIONS AT A LANDFILL SITE,
Lawrence Livermore National Lab., CA.
J. J. Sweeney.
Ground Water Monitoring Review, Vol. 4, No. 1, p 52-59, Winter, 1984. 11 Fig, 5 Ref.

Descriptors: *Groundwater pollution, *Landfills, *Monitoring, *California, Water pollution control, Electrical resistivity, Electrical studies, Measuring instruments, Conductivity, Geohydrology.

Two electrical methods were used and compared in the investigation of a solid waste landfill site in the central Coast Ranges of California. Terrain conductivity measurements and dipole-dipole resistivity surveys were used in support of an investigation of the hydrology and geochemistry of the site with main concerns being the establishment of baseline conditions, determination of possible contamination and design of a sampling/monitoring system. Electrical properties of rock at low frequencies are dominated by effects due to the presence of pore fluids. Differences in conductivity between saturated and unsaturated rock depend primarily on inherent electrical properties of the rock, porosity and conductivity of the fluid. Electrical detection of subsurface zones of contamination, sometimes referred to as plumes, in either the saturated or unsaturated zones requires the existence of a zone of contrasting electrical behavior produced by the contamination. In areas where materials with contrasting electrical properties are present in the subsurface with irregular geometry, anomalies can be difficult to interpret and additional information about geology and ground water conditions must be relied upon. It appeared that the two electrical methods complement each other in the investigation of local hydrologic characteristics. (Baker-IVI)
W84-04644

BATTERY OPERATED INCUBATOR FOR IN SITU PRIMARY PRODUCTIVITY STUDIES IN SMALL LAKES AND RIVERS,
University Coll., Cardiff (Wales). Dept. of Plant Science.
J. E. Furet, K. Benson-Evans, and J. E. Grey.
Hydrobiologia, Vol. 101, No. 3, p 243-245. May, 1983. 3 Fig, 10 Ref.

Descriptors: *Phytoplankton, *Primary productivity, *Measuring instruments, Incubators, Rivers, Aquatic life.

The main problem of determining primary productivity for routine phytoplankton studies in freshwater is that of changes in natural illumination. A portable, immersible incubator to measure the primary productivity of phytoplankton is described. Battery operated and inexpensive, it is designed to overcome the problem of changes in natural illumination. Tested over 3 yr, using the C-14 technique, it is now successfully used in research work on South Wales rivers. This incubator is not submersible. When used in a lake or river it can be kept in position with stones to avoid effects of excessive turbulence. It can be used on board a boat also provided that the conditions are calm during the period of incubation. Total weight of the incubator when empty is 2.4 kg, including the flex. (Baker-IVI)
W84-04715

A VERSATILE COMPUTER-CONTROLLED TRACKING AND SAMPLING SYSTEM FOR USE WITH MODEL LAKES IN TALL TUBES,
Edinburgh Univ. (Scotland). Grant Inst. of Geology.
For primary bibliographic entry see Field 2H.
W84-04755

7C. Evaluation, Processing and Publication

WATER-LEVEL RECORDS FOR THE NORTHERN HIGH PLAINS OF COLORADO, 1979-83,
Geological Survey, Lakewood, CO. Water Resources Div.
J. L. Blattner, and B. D. Rasmuson.
USGS Open-File Report 83-253, 1983. 34 p, 2 Fig, 1 Tab.

Descriptors: Water management, *Water level, *Water level fluctuation, *Colorado, Northern High Plains of Colorado, Ogallala Formation.

Water-level measurements were made in 638 wells in the winter of 1982-83, in the northern High Plains of Colorado. The water-level measurements for the winter of 1982-83 and for four preceding winters are given in a table, which also contains the location, depth, land-surface elevation and the aquifer for each well. (USGS)
W84-04245

PUMPAGE DATA FROM IRRIGATION WELLS IN EASTERN LARAMIE COUNTY, WYOMING, AND KIMBALL COUNTY, NEBRASKA,
Geological Survey, Cheyenne, WY. Water Resources Div.
C. Avery.
USGS Open-File Report 83-29, 1983. 23 p, 2 Fig, 2 Tab, 4 Ref.

Descriptors: *Pumping, Irrigation practices, *Water well data, Water distribution, Groundwater, *Wyoming, *Nebraska, *High Plains RASA, Irrigation wells.

Quantitative information concerning pumpage by irrigation wells is an integral component of the U.S. Geological Survey High Plains Regional Aquifer System Analysis. Thus, operation time, discharge rate, and irrigated acreage were measured at approximately 450 randomly selected irrigation wells within 10 areas of the High Plains during the 1980 irrigation season. The data were used to estimate the seasonal mean application of water to crops and to project total pumpage by irrigation wells in 1980 throughout the High Plains area. As part of the sampling effort, 50 irrigation wells were randomly chosen from the area of eastern Laramie County, Wyoming, and Kimball County, Nebraska. Required information was collected on only 40 of the wells. For these wells, the seasonal mean application of water on the irrigated land was 15.2 inches. For the major crop types, the seasonal mean application, in inches, were as follows: alfalfa, 19.8; corn, 15.4; potatoes, 13.8; beans, 12.8; and small grains 10.2. (USGS)
W84-04248

WATER AND STREAMBED-MATERIAL DATA, EAGLE CREEK WATERSHED, INDIANA, AUGUST 1980, OCTOBER AND DECEMBER 1982, AND APRIL 1983: UPDATING OF U.S. GEOLOGICAL SURVEY OPEN-FILE REPORT 83-215,
Geological Survey, Indianapolis, IN. Water Resources Div.
D. J. Wangsness.
USGS Open-File Report 83-532, 1983. 51 p, 2 Fig, 29 Tab, 4 Ref.

Descriptors: *Indiana, *Water quality, Organic compound, *Bottom sediments, *Hazardous materials, *Surface water, Eagle Creek watershed, Finley Creek.

Water-quality surveys within the Eagle Creek watershed were done by the U.S. Geological Survey in August 1980, October and December 1982 and April 1983 in cooperation with the city of Indianapolis, Department of Public Works. Streambed-material and water samples were collected from Finley and Eagle Creek and was analyzed for selected metals, insecticides, and acid-extractable and base-neutral-extractable compounds. Water samples also were analyzed for volatile organic compounds. The 1982-83 surveys represent different flow conditions. This report lists all the data collected and analyzed by the U.S. Geological Survey but does not interpret any of the results.
W84-04249

WATER RESOURCES DATA, MONTANA, WATER YEAR 1982: VOLUME 2. COLUMBIA RIVER BASIN,
Geological Survey, Helena, MT. Water Resources Div.
R. R. Shields, J. R. Knapton, M. K. White, M. A. Jacobson, and M. L. Kasman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-118561. Price codes: A09 in paper copy, A01 in microfiche. USGS Water-Data Report MT-82-2, 1983. 184 p, 7 Fig, 5 Tab.

Descriptors: *Montana, *Hydrologic data, Surface water, Groundwater, *Water quality, Flow rate, *Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections, *Columbia River basin.

Water resources data for the 1982 water year for Montana consist of records of stage discharge, and water quality of streams; stage, contents and water quality of lakes and reservoirs; and water levels in wells. Volume 2 of this report contains discharge records for 46 gaging stations; stage/contents for 3 lakes and reservoirs; water quality for 19 stations, 3 lakes; water levels for 14 observations wells. Also included are 31 crest-stage partial-record stations and 20 smaller reservoirs. Additional water data were collected at various sites, not part of the systematic data collection programs, and are published as miscellaneous measurements. (USGS)
W84-04250

WATER RESOURCES DATA, MONTANA, WATER YEAR 1982: VOLUME 1. HUDSON BAY AND MISSOURI RIVER BASINS,
Geological Survey, Hartford, CT. Water Resources Div.
R. R. Shields, J. R. Knapton, M. K. White, M. A. Jacobson, and M. L. Kasman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-117506. Price codes: A24 in paper copy, A01 in microfiche. USGS Water-Data Report MT-82-1, 1983. 553 p, 10 Fig, 8 Tab.

Descriptors: *Montana, *Hydrologic data, Surface water, Groundwater, *Water quality, Flow rate, *Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections, *Hudson Bay basin, *Missouri River basin.

Water resources data for the 1982 water year for Montana consist of records of stage, discharge, and water quality of streams; stage, contents and water quality of lakes and reservoirs; and water levels in wells. Volume 1 of this report contains discharge records for 189 gaging stations; stage only records for 1 lake station; stage/contents for 6 lakes and reservoirs; water quality for 86 stations; water levels for 9 observation wells. Also included are 140 crest-stage partial-record stations and 33 smaller reservoirs. Additional water data were collected at various sites, not part of the systematic data collection programs, and are published as miscellaneous measurements. (USGS)
W84-04251

WATER RESOURCES DATA, CONNECTICUT. WATER YEAR 1982,
Geological Survey, Hartford, CT. Water Resources Div.
C. E. Thomas, Jr., T. B. Shepard, I. S. Gasperini, and S. E. Wing.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-243899. Price codes: A15 in paper copy, A01 in microfiche. USGS Water-Data Report CT-82-1, 1983. 327 p, 6 Fig, 2 Tab.

Descriptors: *Connecticut, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Streamflow, Flow rates, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Biological analyses, Water temperatures, Sampling sites, Water levels, Water analyses, Estuary, *Data collection.

Water Resources Data for the 1982 water year for Connecticut consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground-water wells. This volume contains records for water discharge at 48 gaging stations; storm discharge at 7 gaging stations; tidal volume at 1 gaging station; contents at 35 lakes and reservoirs; water quality at 39 gaging stations, 4 lakes and reservoirs, 2 harbors, 1 precipitation station, 6 partial-record stations, and 10 wells; and water levels at 59 observation wells. Also included are 41 crest-stage partial-record stations. Locations of these sites are shown on figures 4, 5, and 6. Additional water data were collected at various sites involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. (USGS)
W84-04252

WATER RESOURCES DATA, LOUISIANA, WATER YEAR 1982, VOLUME 1: CENTRAL AND NORTHERN LOUISIANA,
Geological Survey, Baton Rouge, LA. Water Resources Div.
D. D. Carlson, G. R. Stallworth, L. J. Dantin, and C. G. Stuart.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-118546. Price codes: A18 in paper copy, A01 in microfiche. USGS Water Data Report La-82-1, 1983. 422 p, 8 Fig.

Descriptors: *Louisiana, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection, Lower Mississippi River basin.

Water resources data for the 1982 water year for Louisiana consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This report, in two volumes, contains records for water discharge at 77 gaging stations (including stage for 65 of these stations); stage only for 64 gaging stations and 9 lakes; contents for 1 reservoir; water quality for 104 surface-water (including 31 gaging stations), 20 miscellaneous sites, and 8 lakes, and 223 wells; and water levels for 526 observation wells. Also included are data for 209 crest-stage and flood-profile partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering states are also included in this report. (USGS)
W84-04253

WATER RESOURCES DATA, LOUISIANA, WATER YEAR 1982, VOLUME 2: SOUTHERN LOUISIANA,
Geological Survey, Baton Rouge, LA. Water Resources Div.
D. D. Carlson, G. R. Stallworth, L. J. Dantin, and C. G. Stuart.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-229658, Price codes: A18 in paper copy, A01 in microfiche. USGS Water-Data Report LA-82-2, 1982. 404 p, 18 Fig.

Descriptors: *Louisiana, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection, Lower Mississippi River basin, Gulf of Mexico.

Water resources data for the 1982 water year for Louisiana consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This report, in two volumes, contains records for water discharge at 77 gaging stations (including stage for 65 of these stations); stage only for 64 gaging stations and 9 lakes; contents for 1 reservoir; water quality for 104 surface-water stations (including 31 gaging stations), 20 miscellaneous sites, and 8 lakes, and 223 wells; and water levels for 526 observation wells. Also included are data for 209-crest-stage and flood-profile partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering states are also included in this report. (USGS).
W84-04254

WATER RESOURCES DATA, NEW JERSEY, WATER YEAR 1982, VOLUME 1: ATLANTIC SLOPE BASINS, HUDSON RIVER TO CAPE MAY,
Geological Survey, Trenton, NJ. Water Resources Div.
W. R. Bauersfeld, E. W. Moshinsky, E. A. Pustay, and F. L. Shaefer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-119726. Price codes: A15 in paper copy, A01 in microfiche. USGS Water Data Report NJ-82-1, 1983. 329 p, 7 Fig, 3 Tab. Prepared in cooperation with the New Jersey Department of Environmental Protection and with other agencies.

Descriptors: *New Jersey, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analysis, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections, Hudson River basin.

Water Resources data for the 1982 water year for New Jersey consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This volume of the report contains discharge records for 77 gaging stations; tide summaries for 76 surface-water sites and 158 wells; and water levels for 49 observation wells. Also included are data for 42 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements. (USGS)
W84-04255

WATER RESOURCES DATA, NEW JERSEY, WATER YEAR 1982, VOLUME 2: DELAWARE RIVER BASIN AND TRIBUTARIES TO DELAWARE BAY,
Geological Survey, Trenton, NJ. Water Resources Div.
W. R. Bauersfeld, E. W. Moshinsky, E. A. Pustay, and F. L. Schaefer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-119734. Price codes: A10 in paper copy, A01 in microfiche. USGS Water-Data Report NJ-82-2, 1983. 209 p, 7 fig, 3 Tab. Prepared in cooperation with the New Jersey Department of Environmental Protection and with other agencies.

Descriptors: *New Jersey, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, Data collections, Delaware River basin.

Water resources data for the 1982 water year for New Jersey consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This volume of the report contains discharge records for 21 gaging stations; tide summaries for 3 stations; stage and contents for 16 lakes and reservoirs; water quality for 58 surface-water sites and 78 wells; and water levels for 23 observation wells. Also included are data for 27 crest-stage partial-record stations, 7 tidal crest-stage gages, and 26 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements. (USGS)
W84-04256

FORTRAN COMPUTER PROGRAMS TO PLOT AND PROCESS AQUIFER PRESSURE AND TEMPERATURE DATA,
Geological Survey, St. Paul, MN. Water Resources Div.
J. B. Czarnecki.
USGS Water-Resources Investigations Report 83-4051, 1983. 50 p, 4 Fig, 27 Tab, 4 Ref.

Descriptors: *Computer programs, *Data processing, *Data storage and retrieval, *FORTRAN program, Aquifer thermal-energy storage, Minnesota, Data plots.

Two FORTRAN computer programs have been written to process water-well temperature and pressure data recorded automatically by a datalogger on magnetic tape. These programs process the data into tabular and graphical form. Both programs are presented with documentation. Sample plots of temperature versus time, water levels versus time, aquifer pressure versus log time, log drawdown versus log 1/time, and log drawdown versus log time/radius squared are presented and are obtained using standard CALCOM directives. Drawdown plots may be used directly to obtain aquifer transmissivities and storage coefficients as well as leakance coefficients. (USGS)
W84-04265

BACKWATER AND DISCHARGE AT HIGHWAY CROSSINGS WITH MULTIPLE BRIDGES IN LOUISIANA AND MISSISSIPPI,
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 8B.
W84-04268

WATER DATA BANK (ARS) - UPDATE,
Agricultural Research Service, Beltsville, MD. Water Data Lab.
J. B. Burford, J. L. Thurman, and R. T. Roberts.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 4, p 1142-1144, July-August, 1983. 8 Ref.

Descriptors: *Data collections, *Hydrological data, Data retrieval, Watersheds, Precipitation, Streamflow.

The USDA-ARS sponsors a continuing program of watershed hydrology research. The studies have involved about 600 individual watersheds. Data summaries have been published for about 500 of the watersheds and complete data files from about 300 watersheds are stored in the water data bank, maintained by the Water Data Laboratory. Data from about 925 precipitation stations associated with the watershed studies are also included in the data bank. Procedures used to obtain, standardize, store and retrieve hydrological data collected in conjunction with the various research projects are reviewed. Data user direct-access procedures are announced. (Baker-IVI)
W84-04459

8. ENGINEERING WORKS

8A. Structures

COMPUTER MODELING OF THE CROSS CANYON CULVERT,
L. C. Rude.
Transportation Research Record 903, p 109-114, 1983. 6 Fig, 13 Ref.

Descriptors: *Culverts, *Design criteria, *Soil mechanics, Construction, Computer models, Model studies, Soil types, Pipes, Overburden.

Three different types of soil models were compared for their effectiveness in predicting the behavior of an underdesigned reinforced concrete culvert installed in a deep fill. The extended Hardin model, a linear elastic model, and two overburden-dependent models were used. The overburden-dependent model predicted the actual behavior with the least error. The analysis was performed by using the CANDE computer program. Only one construction increment was used in conjunction with a surcharge pressure applied to the top of a relatively shallow finite element grid to simulate additional overburden. The program reasonably predicted prefailure and postfailure behavior of the pipe culvert. The need to accurately represent the actual boundary condition in backfiguring overburden-dependent values was also shown. (Baker-IVI)
W84-04190

SURGE PROTECTION OF WATER SUPPLY PIPELINES FOR JUBAIL INDUSTRIAL CITY,
R. L. B. Pearce, and E. P. Evans.
Proceedings of the Institution of Civil Engineers, Vol. 76, p 249-268, February, 1984. 12 Fig, 3 Tab, 10 Ref.

Descriptors: *Protection, *Water conveyance, *Pipelines, *Jubail, Desalination plants, Design criteria, Civil engineering, Structural engineering, Water supply, Water supply development, Water treatment facility, Saudi Arabia.

The infrastructure for Jubail Industrial City will include facilities for the distribution of over 1 100 000 cu m/day of desalted seawater to both industrial complex and community. Pipes of up to 1500 mm dia. will be installed in flat terrain, the total length of pipework in the primary system being of the order of 150 km. The Paper describes the water distribution system, with storage reservoirs and pumping stations, for which most of the design work has been completed and construction has commenced. The computer program and basic data adopted for the surge analysis are discussed, together with their application to the industrial complex network, the bulk supply to the community and the suction main from the storage reservoir to the main pumping station. Plots are shown of low pressure areas occurring and of variation of transient pressures with time; critical transient pressures are shown to occur due to pump stoppage and due to the closure of valves at reservoir inlets. The surge protection measures studied and analyzed by computer include the provision of bypasses at the main pumping station, elevated tanks, air vessels, two-stage valve closure and multiple reservoir inlet valves. The control of the main pumping plant by flowmeters, make-up pumps and reservoir inlet valves is discussed. (Author's abstract)
W84-04204

THE VIEUX-PRE DAM (AMENAGEMENT DE VIEUX-PRE),
S. Alam, and R. Longuemare.
La Houille Blanche, No. 3/4, p 177-184, 1983. 5 Fig, 14 Ref.

Descriptors: *Vieux-Pre dam, *Dams, Dam design, Design criteria, Hydraulic design.

The Vieux-Pre dam, located in the East of France in the foothills of the Vosges mountains is formed by a 10 m high embankment dike. In installing the ancillary structures, some very interesting hydraulic problems had to be solved. These structures are a bottom outlet and a shaft spillway operating under a head of roughly 62 m and discharging into the same tailrace tunnel. The problem with the bottom outlet was to ensure that the outlet structure, which is a flat gate, would operate without risk of cavitation and that the downstream jet would be adequately aerated, thus allowed for free flow of the jet and the dissipation of energy along the tail-race tunnel. For the spillway, the first problem was to ensure free fall into the vertical shaft with massive induction of air to avoid all risk of cavitation and then to discharge the air in a continuous stream (without hammering) by securing a free surface flow at the outlet of the tunnel connecting the tail-race tunnel, in the neighborhood of the outlet gate chamber of the bottom outlet. The paper discusses the design hydraulic forms on a 1:20 scale-model to verify the satisfactory operation of all facilities, to estimate the air flow needed for the operation of the bottom outlet, and to ascertain the minimum slope required for free surface flow with a rapid deaeration of the emulsified air in the tunnel downstream from the shaft spillway. (Murphy-IVI)
W84-04213

SAINT-GUILLERME II. THE CLAPIER FACILITIES (REAMENAGEMENT DE LA CHUTE DE SAINT-GUILLERME II OUVRAGES DU CLAPIER),
Electricite de France, Grenoble. Groupe Regional de Production Hydraulique.
J. C. Millet.
La Houille Blanche, No. 3/4, p 185-191, 1983. 7 Fig, 21 Ref.

Descriptors: *Saint Guillerme II, *Dam design, Rehabilitation, Dam construction, Materials engineering.

Electricite de France (E.D.F.) is often confronted with the problem of the resistance of concrete aprons subjected to considerable stress, i.e. high speeds, travelling solids or the impact of spilling waves. The GRPH of the Alps region encountered this problem at the Clapier dam and opted for two approaches: a) an anti-wear granite coating: this conventional alternative relies on the resistance of granite, which has proven its value in many installations. The reinforced concrete pedestal which is part of the working structures of the dam is paved with blocks of granite equipped with instruments and sealed with cement mortar. This solution was adopted despite its cost, for apron surfaces subjected to the greatest stress. b) an anti-wear resin coating: E.D.F. has chosen to use a resin anti-wear coating for the remainder of the surface of the apron. A resinous concrete has been applied after smoothing the surface on non-plane parts with mortar. The reequipment of the St.-Guillerme II fall on the Romanche in the Isere department has made it possible to increase the harnessed rate of flow from 12 cu m/sec. to 45 cu m/sec. This necessitated the rehabilitation of the downstream basin at the 'Clapier' to transform it into a demodulation basin and stabilize to downstream rates of flow values below 30 cu m/sec. under normal operating conditions. The clapier dam thus includes a demodulated flow outlet in addition to the spillway passages. The article describes the specific approach adopted for the outlet and the facilities selected to prevent scouring downstream of the spillway. (Murphy-IVI)
W84-04214

CONTRIBUTION TO THE STUDY OF THE PROTECTION AGAINST ABRASION AND IMPACTS AFFECTING HYDRO-ELECTRIC FACILITIES (CONTRIBUTION A L'ETUDE DE LA PROTECTION CONTRE L'ABRASION ET LES CHOCS DES OUVRAGES HYDRAULIQUES),
Sika Finanz A.G., Baar (Switzerland).
J. Gentil, and J. Mousty.
La Houille Blanche, No. 3/4, p 193-199, 1983. 7 Fig, 2 Tab, 7 Ref.

Descriptors: *Abrasion, *Hydroelectric plants, Corrosion, Materials engineering, Design criteria, Materials testing, Dam design, Khashm El Girba, Sudan, Vinca Dam, Grand-Maison Dam, Chambon Dam, France.

A comprehensive introduction to problems in dam design and solutions for material usage is presented as well as the development of new techniques for use in design criteria. Abrasion and corrosion is a major concern for design criteria. The development of new materials and the improved use of conventional materials increases the options for dam design criteria. Blended concretes, corundum concretes, granite slabs and resinous mortars can protect the facilities against major repair costs. Laboratory tests (abrasion under water, adherence, impact testing) allows the quality of the materials used to be checked and provide technical results and findings. Developments of the worksites Khashm El Girba in the Sudan, the Vinca dam, Grand-Maison and Chambon in France were discussed. (Murphy-IVI)
W84-04215

DESIGN OF SPILLWAYS AND OUTLET WORKS OF SOUAPITI DAM (GUINEA) (CONCEPTION DES OUVRAGES D'EVACUATION DES CRUES ET DE VIDANGE DU BARRAGE DE SOUAPITI (GUINEE)),
Bureau d'Ingenieurs-Conseils, Paris (France).
A. Dejoux, P. Meilland, and J. Sterenberg.
La Houille Blanche, No. 3/4, p 221-230, 1983. 10 Fig, 1 Tab, 2 Ref.

Descriptors: *Souapiti Dam, *Design criteria, *Spillways, *Guinea, Dam design, Outlets, Outlet channels, Diversion tunnels, Diversion structures, Konkoure River.

The Souapiti dam project on the Konkoure in Guinea is a 130 m high earthfill dam. The development includes a free sill spillway and two provisional diversion tunnels to be used on completion of the dam as outlets for the reservoir. The free sill spillway of the Souapiti dam has a maximum flow of 4500 cu m/sec. for a head of 120 m. As the facility is called on to operate frequently, it is open to risks of cavitation, and to avoid these, the projected layout is: a very broad chute (80 meters), and installation on the chute of two deflectors for aerating the through-flow. The layouts have been studied on a 1:100 and a 1:20 scale-model. The projected outlets include tilted tunnels connected to the lower provisional diversion tunnels. Two narrows placed in each lower diversion tunnel create a jump and ensure the downstream loading of through-flows. Special measures are envisaged for the deaeration of through-flows. (Murphy-IVI)
W84-04218

RESTRUCTURING OF THE SPILLWAY OF THE DJORF-TORBA DAM (RESTRUCTURATION DU DEVERSOIR DE DJORF-TORBA),
Ministere de l'Hydraulique, Algiers (Algeria). Direction Generale de l'Exploitation.
M. S. Belouni, T. Sahraoui, J. Bouloc, and B. Goguel.
La Houille Blanche, No. 3/4, p 231-239, 1983. 12 Fig, 1 Tab, 24 Ref.

Descriptors: *Djorf-Torba Dam, *Spillways, Design criteria, Dam design, Structure, Physical properties, Stress analysis.

This large Algerian dam built near Bechar above a vast sub-Sharian catchment basin was completed in 1968. Its spillway is formed of tiered sills on a 35 m high gravity dam. It is designed to release up to 3500 cu m/sec. on to a deflector apron 100 meters wide. The reasons for the consolidation and restructuring of the facility and the consistency of the projected work are examined: apron anchored in the limestone foundations, construction of a downstream sill, further raising of the river-walls, and verification that the concrete surface is smooth and defect-free. The 1:50 hydraulic scale-model has been an invaluable tool for this study. After a few months testing, it was clear that it would not be necessary to lengthen the apron or deepen the existing cut-off. But in its present condition, there is an unacceptable risk of the floor slabs loosening. The solution will be to build a plain continuous reinforced concrete wier 2 m high at the downstream edge, and raise the existing training walls. (Murphy-IVI)
W84-04219

DETERMINATION OF PRESSURE LOSSES OF BARRAGES ON A RIVER AND PROTECTION OF THE DOWNSTREAM BED (DETERMINATION DES PERTES DE CHARGE DES BARRAGES MOBILES EN RIVIERE ET DES DI-

MENSIONS DE LA PROTECTION DU LIT EN AVAL),
Laboratoire Central d'Hydraulique de France, Maisons-Alfort.
J. Bouloc, and A. Petitjean.
La Houille Blanche, No. 3/4, p 261-274, 1983. 15 Fig, 7 Ref.

Descriptors: *Pressure loss, *Barrages, Barriers, Water pressure, Flooding, Downstream bed, Rock fill, Design criteria.

When designing barrages for navigation, the fixed part of the dam (apron, piers), must be built as substantially as possible in relation to the mobile part (obstruction), while remaining within acceptable limits of water-pressure losses during flooding (maximum admissible: 1 meter). In this regard, the various parameters causing and influencing loss of water pressure must be subjected to fine analysis. The scale-model study has yielded a set of abacuses, giving the water pressure loss for eight types of sills and various rates of flow, the height of upstream of shut-off of the apron, and the downstream water level. The study has also revealed the minimum requirements for a rockfill plane as a remedy to the erosion of the downstream bed. (Author's abstract)
W84-04223

CHAMBON DAM OPENING OF THE ORIGINAL BOTTOM OUTLET (BARRAGE DU CHAMBON OUVERTURE DE LA VIDANGE DE FOND D'ORIGINE),
Electricite de France, Grenoble. Groupe Regional de Production Hydraulique.
J. C. Millet.
La Houille Blanche, No. 3/4, p 275-279, 1983. 4 Fig, 9 Ref.

Descriptors: *Chambon Dam, *Bottom outlets, Outlets, Gravity dam, Drainage systems, Hydraulic engineering, Fouling, Mudflows.

The concrete gravity dam of Chambon was originally equipped with an outlet at altitude 951.5 meters. As the facility had become inoperative following fouling of the reservoir by mud, a new drainage was installed at level 959. The reservoir was drained at the beginning of 1980 to level 963, and the decision was taken to recommission the original outlet. The outlet was opened under a 30 m pressure. The gate was opened before the cover was blown up, and the explosion of the plug bolts was synchronized. A powerful clean-water injector was used and maintained until the reservoir had been completely emptied. The precautions made it possible to solve a problem for which twenty years ago no answer had been found. It is believed that in the future repetition of this operation at judicious chosen intervals would help prevent renewed fouling of the reservoir by mud. (Murphy-IVI)
W84-04224

NEW WATERWORKS FOR THE REDEVELOPMENT OF BAGHDAD CITY, WITH PARTICULAR REFERENCE TO THE LARGE DIAMETER TRANSMISSION PIPELINES,
For primary bibliographic entry see Field 5F.
W84-04308

A LABORATORY INVESTIGATION OF COUNTERBALANCED FLAP GATES FOR WATER LEVEL CONTROL,
Cranfield Inst. of Tech. (England).
M. G. Kay, and D. A. Ashton.
Journal of Hydrology, Vol. 71, No. 1-2, p 165-179, March 1984. 4 Fig, 7 Tab, 8 Ref.

Descriptors: *Gates, *Water level control, Design criteria, Counterbalanced flap gate, Flap gates, Water level, Canals, Irrigation canals, Channels, Developing countries.

In open channels there is often a need to control water levels within reasonably fine limits over wide ranges of flow. Gates are available which will provide the degree of control needed but they tend to be complex and expensive. A rectangular flap gate, fitted with counter-balance weights can be adjusted to control water levels in a channel under free flow conditions. The counterbalanced flap gate shows considerable promise for water level control as indicated by a model test which is described. It is simple and cheap to construct, and would be well within the manufacturing capabilities of rural workshops in developing countries. (Baker-IVI)
W84-04313

FINITE ELEMENT MODELING FOR DEPTH AND SPACING OF DRAINS IN LAYERED SOILS,
Michigan State Univ., East Lansing. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2F.
W84-04428

COST FUNCTIONS OF WATER CONVEYANCES FOR GRAVITY IRRIGATION,
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4A.
W84-04452

STABILITY OF CONCRETE DAM: CASE HISTORY,
American Electric Power Service Corp., New York.
W. W. Stelle, D. I. Rubin, and H. J. Buhac.
Journal of Energy Engineering, Vol. 109, No. 3, p 165-180, September, 1983. 9 Fig, 2 Tab, 14 Ref.

Descriptors: *Dam stabiity, *Concrete dams, Claytor Dam, Floods, Limestone, Karst, Probable Maximum Flood.

Claytor Dam is located on the New River in Virginia. It was constructed between 1938 and 1941 for hydroelectric generation and it has been in service from that date. The stability of Claytor Dam was reevaluated under Probable Maximum Flood (PMF) conditions. The structure is a concrete gravity dam with a gated spillway. The foundation is karstic limestone that was treated before construction. The anchor wall at the upstream face of the dam plays an important role in structure stability. The dam was originally designed to pass 258,000 cfs (7,306 cu m/s), and was reanalyzed under PMF flows of about 1,100,000 cfs (31,149 cu m/s). At this flow, the dam is overtopped by 62.5 ft at spillway section, and 25 ft above the crest of the dam. The recognition and understanding of geologic conditions proves to be important especially when combined with the contribution of the anchor wall in the stability analyses. An attempt to evaluate bonding at the interface was inclusive. Careful drilling procedure and equipment are vital to obtaining samples suitable for testing. In a cracked base analysis the bond tensile strength at the rock concrete interface played a critical role. When bond tensile strength at the interface was neglected, the cracked base analysis indicated that the dam was unstable. (Baker-IVI)
W84-04488

NEW ROLE OF DRAINAGE SYSTEMS IN DAM STABILITY,
American Electric Power Service Corp., New York.
W. W. Stelle, D. I. Rubin, H. J. Buhac, and P. H. Anderson.
Journal of Energy Engineering, Vol. 109, No. 3, p 181-191, September, 1983. 5 Fig, 1 Tab, 8 Ref.

Descriptors: *Dams, *Stability, *Drainage systems, Drains, Maximum Probable Flood, Cracks, Pressure distribution, Stress analysis, Claytor Dam.

Foundation drains have long been used for reducing uplife pressures under masonary dams. It has been assumed that when tension develops at the heel of a dam, full headwater pressure extends for the entire tension zone. Recent studies demonstrate that foundation drains continue to function and result in significantly lower uplift pressure, causing dams to be subject to more severe loading conditions than had been considered in the design as stable. The finite element method of analysis is used to estimate the dimensions of a potential crack under a gravity structure which includes an upstream key into the foundation rock mass and internal drains. This analysis of the Claytor Dam for the PMF (Probable Maximum Flood) condition shows that the crack length stabilizes, the compression and shear stresses do not exceed the allowable stresses, and the sliding stability for the uncracked portion is adequate. In this analysis, neither any tensile bond between the concrete and foundation rock that may exist nor the sliding resistance provided by the anchor wall has been used. (Baker-IVI)
W84-04489

PROCEDURE FOR ESTIMATING SURFACE-WATER INTAKE COSTS,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
T. M. Walski, J. S. Condra, and K. Cable.
Journal of Environmental Engineering, Vol. 110, No. 2, p 381-391, April, 1984. 5 Fig, 1 Tab, 10 Ref.

Descriptors: *Intake costs, *Cost analysis, *Surface-water intakes, *Estimating, Estimated costs, Estimating equations, Design criteria.

Previously developed cost estimating procedures for surface-water intakes have been based primarily on a simple correlation of intake cost with one design parameter (e.g., design flow or total system cost). The cost estimating procedures correlate intake cost with a number of system components such as pipeline type and length (subaqueous or bridge-supported), bridge type (pedestrian or vehicle), and pumping requirements (pumps and pump housing). Capital and operation and maintenance costs are determined for two types of intake structures, submerged and exposed tower. Costs generated by this procedure are compared with actual project costs. The average absolute value percent error in comparing these costs is 13.9 with a range of 1.3%-26.8%. This procedure is also compared to existing cost estimating methodologies. Costs derived by the procedure presented are believed to be more accurate due to the consideration of several site-specific variables. (Murphy-IVI)
W84-04597

DAM SAFETY IN THE UNITED STATES,
R. B. Jansen.
International Water Power and Dam Construction, Vol. 36, No. 4, p 17-20, April, 1984. 3 Fig.

Descriptors: *Dam failure, *Legislation, States rights, Federal authority, Safety, Dams, Construction, Inspection, Public safety.

In recognition of the increasingly apparent problems with dams in the United States, a presidential memorandum in 1977 ordered a review of federal dam safety activities. This resulted in various reports, leading to a significant revision of practices in most federal agencies. In June 1979 the Federal Coordinating Council for Science, Engineering and Technology published the Federal Guidelines for Dam Safety which emphasized inspections to measure existing dams against current criteria; established a federal agency of dam safety offices or officers; and budgeted for implementation of the report's recommendations. Currently the role of state governments in overseeing the safety of non-federal dams is being brought into sharper focus. Most states now have laws providing for supervision, and some of these are being strengthened. Many dam safety problems have common denominators and call for cooperation among the federal and state governments and dam owners. Although federal authority over non-federal dams is limited, the national leadership must assist in ensuring public safety. (Baker-IVI)
W84-04663

UNDERGROUND MINING NEAR LARGE AUSTRALIAN DAMS,
New South Wales Dam Safety Committee, Sydney (Australia).
B. L. Cantwell, and L. M. Whitfield.

International Water Power and Dam Construction, Vol. 36, No. 4, p 20-24, April, 1984. 4 Fig, 2 Ref.

Descriptors: *Coal mining, *Dam stability, *New South Wales, *Australia, Safety, Reservoirs, Dam construction, Mining, Dam failure.

Underground coal mining is an important industry in New South Wales. Many of these mines are located under or adjacent to large dams and reservoirs. Practices currently used by the Dams Safety Committee to ensure the continuing safety of the dams and reservoirs are discussed. To date the Committee has dealt with thirty mining applications which have required some form of monitoring. These have covered a variety of mine layouts and methods of extraction, ranging from development of access headings through bord and pillar mining to longwall mining systems. In the majority of cases total extraction has been restricted to outside the marginal zone, but some partial or total extraction has been allowed under the structure and reservoir of privately owned minor dams. No mining has been allowed under a major water supply dam. The majority of mining adjacent to dams or reservoirs has taken place without effect on the security of the dam or its storage. (Baker-IVI)
W84-04664

LEGAL ASPECTS OF DAM SAFETY,
Western New England Coll., Springfield, MA. School of Law.
For primary bibliographic entry see Field 6E.
W84-04665

STORAGE LOSSES IN RESERVOIRS,
W. H. Graf.
International Water Power and Dam Construction, Vol. 36, No. 4, p 37-40, April, 1984. 5 Fig, 2 Tab, 27 Ref.

Descriptors: *Reservoirs, *Sedimentation, *Storage loss, Design criteria, Sediment distribution, Deposition, Sediment transport, Trap efficiency, Watershed management.

It is important to be able to predict the sediment deposition, its distribution, and the storage loss which will occur when considering the design and operation of a reservoir. If sufficient data existed on the hydraulics of the deposition pattern and its volumetric storage depletion effect, it would be possible to calculate the exact storage loss. The empirical methods which have been developed for the immediate solution of the problem are examined. Storage loss measured as trap efficiency (the ability of a reservoir to trap and/or retain the sediment which enters it) will depend mainly on: the characteristics of the watershed, the water and sediment inflow into the reservoir, the reservoir's storage, and the water and sediment outflow from the reservoir. Five approaches to determining trap efficiency are considered. There are three basic techniques used for reservoir sedimentation surveys: for filled reservoirs use of sonic equipment is required, measuring primarily the reservoir bottom, and terrestrial surveying or aerial photogrammetric equipment, measuring the water surface; for empty reservoirs aerial photogrammetric equipment is used measuring the reservoir bottom; and for partly empty reservoirs a combination of the above methods is employed. The most effective control measure involves control of the watershed. Such control may be feasible on small watersheds, however, in larger ones it may be an expensive and long-term undertaking. Control of the inflow of sediment into the reservoir area can be achieved by proper watershed management and supplemented with engineering structures throughout the watershed. Control of deposition begins with the proper design of the reservoir, which must fit into the erosion-sedimentation pattern of the region. (Baker-IVI)
W84-04667

OPTIMAL DIAMETERS FOR PRESSURE PIPES OF HYDRO PLANTS,
Padua Univ. (Italy). Ist. di Idraulica.
L. Da Deppo, and C. Datei.
International Water Power and Dam Construction, Vol. 36, No. 4, p 41-44, April, 1984. 2 Fig, 2 Tab, 6 Ref.

Descriptors: *Hydroelectric plants, *Design criteria, *Pressure pipes, Linear programming, Penstocks, Tunnels, Model studies, Optimization.

A procedure is presented for determining the optimal distribution of the diameters of tunnels and penstocks for hydroelectric plants using an integer linear programming technique. The validity of the model, and a numerical example using existing equipment are discussed. Linear equality as well as linear inequality constraints can be handled by the proposed procedure. The optimal diameters are selected from those determined by common engineering practice. Cost effective criteria have been used, without the need for further definitions for cost functions of various natures and degrees of approximation. (Baker-IVI)
W84-04668

IMPROVING THE EFFICIENCY OF UTILIZATION OF HYDROBIOLOGICAL DATA IN THE DESIGN OF NEW RESERVOIRS,
All-Union Hydraulic Engineering Inst., Leningrad (USSR).
T. G. Kokoliya.
Hydrobiological Journal, Vol. 19, No. 3, p 32-34, 1983.

Descriptors: *Reservoirs, *Construction, *Decision making, Design criteria, Planning, Standards, Communication, Hydrobiological parameters.

Urgent problems of hydrobiological research and data utilization in the design of new reservoirs are discussed. The need for standardization for hydrobiological information is emphasized, and the basic problems likely to be encountered are defined. To improve the efficiency of utilization of the biological data by other specialists, the form of their presentation should be standardized on the basis of a single scale of hydrobiological parameters and units of measurement. For practical utilization the following list is suggested: list of the essential biological parameters characterizing the phenomenon under study, units of measurement; standard (or natural) magnitude, and units of its measurement; actual value of the parameters, obtained by a proven method, and units of their measurement; comparison of the values obtained with the standard values and with the temporary variability in the same parameters; assessment of the changes recorded; analysis of results taking into account other parameters and their effects; assessment of interaction; prediction of the further course of processes and changes in parameters; and conclusions and recomendations. (Baker-IVI)
W84-04730

EDV-SUPPORTED CALCULATION OF GROUNDWATER DRILLING INSTALLATIONS WITH THE GROUNDWATER DRILLING PROGRAM PACKAGE - PART 2 (EDV-GESTUTZTE BERECHNUNG VON GRUNDWASSERABSENKUNGSANFAGEN MIT DEM PROGRAMMPAKET GRUNDWASSERABSENKUNG - TEIL 2),
Ingenieurhochschule Cottbus (German, D.R.). Sektion Technologie der Bauproduktion.
J. Loeper, and U. Beims.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 3, p 100-101, March, 1983. 2 Fig, 1 Tab, 2 Ref.

Descriptors: *Computers, *Groundwater, *Drilling, Pump tests, Simulation, Pumping rate, Drainage, Costs, Wells.

The application of computer programs to two groundwater drilling projects in the German Democratic Republic is discussed. At the Great Spree Dam in Cottbus, a pump test was necessary to study soil deposition along the courses of the river. Due to unfavorable geology, the test could not be performed in compliance with the standard; therefore a simulated test using the computer program WAPRA 2 was done. The results were used to determine the position of seven wells. The computer program OPENA 1 was then applied to optimize these positions, and results suggested that only six pumps were needed. Finally the program BRUKON 2 was used after completion of drilling to optimize the pumping rate and well dimensions. The latter were reduced by 0.5 m as a result. Optimal pump output could be achieved through the use of only five pumps, decreasing energy use by 7.5 kW over the two-year life of the pumps. Cost savings were 6.5% through OPENA 1 (non-construction and operation of one well) and 5.2% through BRUKON 2 (a second well placed out of action after 20 days). At a construction site in Neubrandenburg, wells had to be dug to rid the site of groundwater. Two galleries were dug, and it was projected that one would contain 18 and the other 22 wells. Position optimization by means of OPENA 1 showed that only 14/18 wells were needed in gallery 1, so that 46 m of drilling was saved and pump output was reduced by 0.0126 cu m/sec. OPENA 1 also suggested that a total of only 414 m drilling was required as opposed to the projected 960 m. A second optimization using BRUKON 2 showed that from day 15 to the end (day 105) of operation, a 181,000 cu m reduction in water volume could be achieved by decreasing pump output (equivalent to output of one pump at 83.8 cu m/hr = 19.440 kW). BRUKON 2 suggested an optimal average well depth of 10.2 m, which was 46.8 m less than that suggested by OPENA 1. (Gish-IVI)
W84-04783

EXPERIENCES IN THE INTEGRATION OF WATER MANAGEMENT FACILITIES INTO THE LANDSCAPE USING TREES (ERFAHRUNGEN BEI DER EINBINDUNG WASSERWIRTSCHAFTLICHER ANLAGEN),
Wasserwirtschaftsdirektion Obere Elbe-Neibe (German, D.R.).
For primary bibliographic entry see Field 4D.
W84-04789

8B. Hydraulics

THIRTY YEARS OF LABORATORY STUDY OF SPILLWAYS (TRENTE ANS D'EVACUATEURS DE CRUES AU LABORATORIE),
Centre National de la Recherche Scientifique, Toulouse (France). Inst. de Mecanique des Fluides.
J. Gruat, C. Thirriot, and D. Trivellato.
La Houille Blanche, No. 3/4, p 209-220, 1983. 20 Fig, 14 Ref.

Descriptors: *Spillways, *Model studies, Hydraulic models, Model testing, Hydraulic similitude, Mathematical studies, Mathematical equations, Reynolds equation, Euler's number, Weber's number, Design criteria, Dams, Dam design.

In planning floodwater control systems all viable alternative methods of securing floodwaters should be examined. Some basic alternative methods of securing transit floodwaters is presented. Problems relating to similitude are described on the basis of scale-models studied in the laboratory. The effect of hydraulics on spillway design is then correlated. Some of the most common spillway designs include ski-jumps, mobile dams and syphon spillways. (Murphy-IVI)
W84-04217

STUDIES ON A SCALE-MODEL OF THE DEAERATION SYSTEMS USED IN WATER-PRESSURE SHAFTS (ETUDES SUR MODELE REDUIT DES DISPOSITIFS DE DEGAZAGE DANS LES PUITS DE MISE EN CHARGE),
H. Pochet.
La Houille Blanche, No. 3/4, p 241-246, 1983. 8 Fig, 9 Ref.

Descriptors: *Deaeration systems, *Water-pressure shafts, Dam design, Aeration process, Hydraulic engineering, Pressure conduits.

Water pressure shafts connecting the canals to the operational tunnels are to be found in several hydro-electric developments designed and executed by the Societe du Canal de Provence. Water dropping into pressure shafts generates air emul-

sions and it is necessary to prevent the air bubbles from entering the tunnels for reasons relating to transport capacity and stability. In one example of study using a scale-model shaft, its volume of air is large enough to release the air without need for a special device. In another case, it was necessary to build a deaeration chamber at the entrance to the tunnel. The third example is original because the solution developed comprises both a jet breaking flow and a deaeration chamber. (Murphy-IVI)
W84-04220

DIVERSION WORKS AND SEDIMENT TRANSPORT (OUVRAGES DE DERIVATION ET TRANSPORTS SOLIDES),
M. Bouvard.
La Houille Blanche, No. 3/4, p 247-254, 1983. 3 Fig, 9 Ref.

Descriptors: *Diversion tunnels, *Sediment transport, Hydraulic engineering, Diversion structures, Civil engineering, Hydraulic design, Strasbourg Dam, Rhine River, Comparison studies.

The River Hydraulics Committee of the AIRH has commissioned the author to document the best practice in the field of 'Diversion works for a river channelling solids', and to write up the 'Rules of the Art'. Although the basic hydraulic problems remain the same, the use of modern civil engineering techniques has greatly facilitated construction. By contrast, basic knowledge about materials driven by flows (bed-load and suspended substances) has not advanced much, and some of it is even being given a second look. It seems that the comparison of the results obtained or used in laboratory work and observed reality is not enough and a major effort is indispensable in this regard. Confidence in conventional formula is diminishing, and the too rare comparisons of these formula with experimental results show that they overkill. Whereas the present theory has it that serious difficulties should be encountered downstream from diversions of substantial flow (raising of the beds), they virtually never occur in practice, despite the number of books examined by the author. In his view, the explanation is that the present theories are all based on results provided by models and the hypotheses on which these models have been formulated could be inaccurate. In particular, paving phenomena - or the change in the size of the material forming the bed - could have a considerable effect on the river. The current theoretical approach to suspended substances travelling in the water is somewhat rigid, and is perhaps based on over-simplistic hypotheses. In any event, it does not allow the treatment of some fundamental aspects encountered when setting the dimension of facilities such as sand traps. (Murphy-IVI)
W84-04221

THE GUERLEDAN PUMPING STATION, (AMENAGEMENT DE GUERLEDAN),
S. Alam, and R. Longuemare.
La Houille Blanche, No. 3/4, p 255-259, 1983. 7 Fig, 5 Ref.

Descriptors: *Guerledan Pumping Station, *Design criteria, Hydraulic design, Design flow, Pumping plants.

The Guerledan development is located in Brittany, France, and consists of an energy transfer pumping station. The report gives a short account of the project and describes the problems encountered. It also discusses the 1:60 scale-model tests undertaken to design a combined intake and outlet structure which minimizes the environmental impact of the project on the reservoir. The proposed layout deals satisfactorily with the problems met. (Author's abstract)
W84-04222

MODELING STREAMLINES AND MASS TRANSPORT IN CIRCULATING FLOW,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
V. Alavian, S. M. Broeren, and D. W. Bintz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-159706, Price codes: A07 in paper copy, A01 in microfiche. Water Resources Center Research Report No. 182, October, 1983. 121 p, 37 Fig, 9 Tab, 32 Ref, 2 Append. Project No. OWRT A-112-ILL (1), Contract/Grant No. 14-34-0001-2115.

Descriptors: *Mass transport, *Mixing, Flow pattern, Circulating flow, *Dispersion, *Finite element, Analysis, Fluid mechanics.

State-of-the-art of hydraulic and water quality modeling in streams and rivers does not include the role of large, slowly circulating regions in dilution and transport of effluents discharged in such water bodies. Examples of circulating regions include meander, blocked arms of the stream, and flow behind engineering structures such as jetties, wing dams and bridge piers. Numerical schemes have been developed to simulate streamline patterns and mass transport within a circulating region approximated by a square cavity on the side of a channel. The circulating flow is assumed two-dimensional (depth averaged) and is generated and maintained by a known main flow at the open boundary. The equation governing mixing and transport of a finite quantity of conservative tracer instantaneously introduced at any location in the flow field has been numerically solved by finite element approximation. Flow geometry is represented by triangular elements, and a linear basis function is used in the interpolation scheme. The unsteady term is approximately by finite differencing in full-forward time steps. Dispersion coefficient has been represented as a tensor, the components of which are functions of the dispersion coefficients along and normal to the streamlines.
W84-04229

BACKWATER AND DISCHARGE AT HIGHWAY CROSSINGS WITH MULTIPLE BRIDGES IN LOUISIANA AND MISSISSIPPI,
Geological Survey, Jackson, MS. Water Resources Div.
B. E. Colson, and V. R. Schneider.
USGS Water-Resources Investigations Report 83-4065, 1983. 39 p, 10 Fig, 5 Tab, 16 Ref.

Descriptors: *Backwater, *Flow profiles, *Discharge measurements, Data collection, Open-channel flow, Mannings equation, Multiple bridges, Gradually varied flow, Energy losses, Indirect discharge measurement, Bridge backwater data, Floods, Bridge backwater computation, *Louisiana, *Mississippi.

Data were collected for nine floods in Mississippi and Louisiana at eight stream crossings having two to six separate bridge openings. Discharge through each bridge, water surface profiles, valley cross sections, and bridge geometry were measured. The multiple openings were divided into equivalent single-opening cases by apportioning interior embankments in direct proportion to the area of openings on either side. Using existing procedures for computer discharge, the bias in computed discharge was 2 percent with a root mean square error of 18 percent. Backwater was computed by two current U.S. Geological Survey methods that use the average flow path in the friction loss term for the approach. One method gave a root mean square error of 0.34 ft. with a bias of -0.25 ft., suggesting that the method underestimates backwater. The other method gave a root mean square error of 0.39 ft with a bias of -0.03 ft. The results indicate that the method developed for single-opening highway crossings can be applied to the multiple bridge crossings. (USGS)
W84-04268

FLUID MECHANICS - A NEW EQUATION IN STABILITY OF UNCONFINED FLOWS,
M. Bouthier.
Comptes Rendus des Seances de l'Academie des Sciences Serie II, Vol. 296, No. 17, p 1293-1296, May 9, 1983. 14 Ref.

Descriptors: *Fluids mechanics, *Unconfined flow, Hydrodynamic stability, Mathematical equations, Hydrodynamics, Stability analysis.

In the field of hydrodynamic stability several amplitude equations have been put forward to study various linear of non linear interactions. In the case of unconfined flows, these equations are proved to allow for modifications and have to be coupled with another new equation. (Author's abstract)
W84-04286

HYDRAULIC GRADIENTS NEAR SUBSURFACE DRAINS AND SOIL EROSION,
Rijksstation voor Landbouwtechniek, Merelbeke (Belgium).
W. Dierickx.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 5, p 1409-1412, September-October, 1983. 5 Fig, 2 Tab, 9 Ref.

Descriptors: *Hydraulic gradient, *Subsurface drains, *Soil erosion, Sand, Radial flow, Electrolytic models, Pipes, Permeable envelopes, Soil particle movement.

In cohesionless sandy soils, high hydraulic gradients may cause soil particle movement into subsurface drains. In unstable structured soils, high hydraulic gradients may lead to aggregate deterioration and soil erosion. For the radial flow case and given design criteria, hydraulic gradients can theoretically be derived near ideal drains and, using the concept of effective radius, near real drains with and without envelope materials. Simulation of symmetrical radial flow towards full flowing drains by means of an electrolytic model showed that high hydraulic gradients occur in the vicinity of the drain circumference. These high gradients are responsible for soil particle movement. A larger diameter pipe only results in a slight decrease of the gradient. The use of voluminous permeable envelopes is the most effective way to reduce the hydraulic gradient and the risk of soil particle invasion. Unsymmetrical radial flow results in still higher hydraulic gradients but also in this case the hydraulic gradients can be reduced by using suitable envelope material. (Moore-IVI)
W84-04466

THE EROSIVE EFFECTS INDUCED BY BOAT PROPELLERS ON THE BOTTOM AND EMBANKMENTS OF WATERWAYS (EFFETS EROSIFS DES JETS D'HELICE DE BATEAU SUR LES FONDS ET LES TALUS DES VOIES NAVIGABLES),
Laboratoire National d'Hydraulique, Chatou (France).
For primary bibliographic entry see Field 2J.
W84-04651

INFLUENCE OF CAVITATION ON NOISE IN MODERN HYDROSTATIC CIRCUITS (INFLUENCE DE LA CAVITATION SUR LE BRUIT DANS LES CIRCUITS HYDROSTATIQUES ACTUELS),
Poclain, Le Plessis-Bellevill (France).
L. Martin.
La Houille Blanche, No. 7/8, p 537-540, 1983. 12 Fig, 7 Ref.

Descriptors: *Cavitation, *Noise, Design criteria, Hydraulic valves, Hydraulic design, Hydrodynamics, Flow characteristics, Comparison studies.

Noise due to cavitation in the flow of hydrostatic high pressure systems is of high frequency (4,000 to 20,000 Hertz) and at levels around 20 dB (linear or balanced). Even when compared to other noises occurring in hydraulic plants (friction, vibration, discharge...) it remains difficult to eliminate especially when important pressure drops are needed for operation of the circuit. More effective design criteria are presented so the frequencies can be pushed beyond the audible zone. (Murphy-IVI)
W84-04654

8C. Hydraulic Machinery

ENERGY RECOVERY USING HYDRAULIC TURBINES IN DEEP UNDERGROUND MINES,
Foster-Miller, Inc., Waltham, MA.
R. N. Torbin, and E. B. Thimons.

Mechanical Engineering, Vol. 105, No. 4, p 57-61, April, 1983. 5 Fig.

Descriptors: *Turbines, *Hydraulic equipment, *Mines, *Hydroelectric power, Cooling water Energy, Water pressure, Mechanical energy, Thermal energy.

Mines are decending to greater depths in the search for minable deposits, but the high temperatures and humidities encountered at these depths make the working environment difficult to maintain. Large quantities of water must be carried down long vertical pipelines to be use for refrigeration. Current practice allows the service and cooling water entering the mine shaft to free fall to the desired depth, where the potential energy is dissipated by friction and momentum transfer. The use of this high pressure water to operate a turbine can result in three benefits to mines: the turbine will generate a significant amount of power, it also generates thermal energy savings equal to the recovered mechanical energy, thus reducing mine refrigeration needs, and it provides a necessary water pressure reduction. The savings from the energy recovered and from the reduced refrigeration needs can pay back the initial investment in an energy recovery system in less than three years in many mine situations. (Baker-IVI)
W84-04198

BULK WATER FLOW TO POWER MARINE BEACONS,
University of Strathclyde, Glasgow (Scotland). Dept. of Thermodynamics and Fluid Mechanics.
A. D. Grant.
Journal of Energy Engineering, Vol. 109, No. 3, p 142-151, September, 1983. 6 Fig, 3 Tab, 4 Ref.

Descriptors: *Hydroelectric power, *Beacons, *Rotors, Generators, Water power, Rivers, Estuaries.

It is possible to generate power by immersing rotors into the otherwise unimpeded flow in a river, estuary, or tidal channels. A solitary submerged rotor will behave in much the same way as a windmill, and will be subject to the same constraints upon its performance. The power density in bulk water flow is generally very low, and large rotor areas are required is a substantial output is necessary. There are, however, applications where localized power sources of modest output are needed. An immersed rotor of the Savonius type used to drive an electrical generator will, given a reasonably efficient generator, enable navigation beacons to be self sustaining in flows with a mean velocity of 1.6 ft/s or higher. A large number of present buoy sites meet this requirement. The rotor used should be immune to the effects of marine growth and should not be prone to fouling. It appears the use of ducting may give a substantial improvement in performance. (Baker-IVI)
W84-04487

ICE POND COOLING SYSTEM FOR POWER PLANTS,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
A. C. Miller, J. A. Pena, J. Urbsanski, and S. N. Kerr.
Journal of Energy Engineering, Vol. 109, No. 3, p 201-206, September, 1983. 2 Fig, 5 Ref.

Descriptors: *Cooling ponds, *Powerplants, *Ice pond cooling, Ice, Pennsylvania, Nuclear powerplants, Cooling water.

A feasibility analysis is reported of the engineering and economical possibilities of a power plant using melting ice to cool the condenser effuent as an alternative approach. In order to designate specific design criteria, the ice pond cooling scheme was theoretically applied to a 1,000 MW nuclear power plant that requires a constant condenser cooling water flow of 1,337 cfs. The study indicated such a plant is indeed feasible and has produced a practical conceptual design for a large ice water sink based primarily on fundamental engineering principles. Analyses conducted in the areas of ice time history and plant performance have shown that the ice required for year round cooling can be readily produced in northern Pennsylvania and effectively used in such a scheme with the possibility of increasing plant output due to more favorable condenser conditions resulting from the cooler water that is made available. The following benefits of the scheme are noted: extremely low evaporative losses, increased plant efficiency, no required blowdown scheme, and the provision of a reservoir sufficient in size to comply with power plant cooling requirements. (Baker-IVI)
W84-04490

CHOOSING PUMPS FOR WATERWORKS,
W. C. Krutzch.
Water Services, Vol. 88, No. 1057, p 93-94 and 97, March, 1984. 3 Fig, 4 Tab, 1 Ref.

Descriptors: *Pumps, *Efficiency, Design criteria, Water distribution, Efficiency.

As energy costs have escalated in recent years, pump users have become more and more aware of the fact that the cost of operating a pump over its lifetime will usually be many, many times its purchase price. Efficiency is of paramount importance. To assure the selection of pumps which will provide maximum efficiency it is first necessary to consider specific speed. For any given combination of capacity and head, specific speed is directly proportional to pump speed, and higher values of the former can only be achieved by increasing the latter. High specific speed pumps are less suited to waterworks services than optimum specific speed designs, aside from any disadvantage they might have in efficiency. Because of the importance attached to both operating efficiency and reliability, it has been a long standing practice in waterworks systems to use multi-pump installations. Reliable achievement of maximum efficiencies requires a conservative approach to impeller inlet design, and to that extent, specifications which recognize that fact are more likely to generate proposals which offer good efficiencies. (Baker-IVI)
W84-04560

THE DEVELOPMENT OF HIGH POWER HYDRAULIC TURBOMACHINES (LE DEVELOPPEMENT DES TURBOMACHINES HYDRAULIQUES DE GRANDES PUISSANCES),
Neyrpic, Grenoble (France).
S. Casacci, and G. Caillot.
La Houille Blanche, Vol. 7/8, p 475-484, 1983. 7 Fig, 3 Ref.

Descriptors: *Turbines, *Hydraulic turbines, *Pump turbines, Performance evaluation, Fluid mechanics, Hydraulic properties, Design criteria, Hydraulic machinery, Hydraulic design, Computers.

Hydraulic turbines are being developed in a number of industrial sectors. Typical for this development is the increase in unit power rating, which reaches 800 MW in one case of turbines and 500 MW for turbine pumps, coupled with an extremely high level of performance. This paper examines how this progress has been achieved by application of the latest knowledge in fluid mechanics and structural mechanics and by development of new production methods. The possibilities opened by the computer-assisted design are also considered. (Author's abstract)
W84-04650

AN EXPERIMENTAL APPROACH TO THE VIBRATORY AND ACOUSTIC PROBLEMS INVOLVED IN FAST PUMPS. AN EXAMINATION OF THE HYDRO-ELASTIC PHENOMENA (APPROCHE EXPERIMENTALE DES PROBLEMES VIBRATOIRES ET ACOUSTIQUES POSES PAR LES POMPES RAPIDES. MISE EN EVIDENCE DES PHENOMENES HYDROELASTIQUES),
Neyrpic, Grenoble (France).
J. C. Guilloud, A. Bonazzi, B. Garnier, and J. C. Bouricot.
La Houille Blanche, No. 7/8, p 521-524, 1983. 4 Fig.

Descriptors: *Pumps, *Pump testing, *Acoustics, *Hydraulic properties, *Hydro-elastic phenomena, *Fast pumps, Hydraulic machinery, Flow velocities, Hydrodynamics, Noise.

Pump vibration must be diminished if the noise emission of a cycle is to be reduced. The present paper highlights the effects of inertia, stiffness and damping produced by the fluid transported. It shows how modification in critical speeds produced by interaction of fluid and pump rotor are generally important (changing individual frequencies, the existence of high damping values). In the near future it will probably become possible to determine these critical speeds in function of the fluid transported and modify them in order to avoid structural resonance and thereby eliminate one of the major causes of noise emitted by a circuit. (Author's abstract)
W84-04653

DYNAMIC BEHAVIOUR OF SAFETY BUTTERFLY VALVES,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
J. Ellis, and W. Mualla.
International Water Power and Dam Construction, Vol. 36, No. 4, p 26-31, April, 1984. 11 Fig, 2 Tab, 1 Ref.

Descriptors: *Dam construction, *Valves, *Butterfly valves, Safety valves, Pipelines, Turbines, Design criteria, Hydroelectric plants.

In hydroelectric powerplant applications, butterfly valves are designed as safety devices, and a primary feature of their operation is that they should close automatically in a safe manner in the event of a pipe rupture or turbine failure. How the closing characteristics of the valves depend on the amount of external torque applied and the properties of the damping mechanism is described. The five cases considered illustrate clearly that, in the event of pipe rupture, different closure curves of the safety butterfly valve can be obtained depending on the amount of external torque applied and the properties of the damping mechanism. The values of the external weight and the ratio of the area of the piston to the area of the opening can be optimized depending on the maximum allowable head on the upstream side of the valve and in the surge tank. (Baker-IVI)
W84-04666

8D. Soil Mechanics

COMPUTER MODELING OF THE CROSS CANYON CULVERT,
For primary bibliographic entry see Field 8A.
W84-04190

ARAB POTASH SOLAR EVAPORATION SYSTEM: DESIGN AND DEVELOPMENT OF A NOVEL MEMBRANE CUT-OFF WALL,
For primary bibliographic entry see Field 3A.
W84-04202

LESSONS TO BE LEARNT FROM AN EMBANKMENT FAILURE,
D. M. Finlayson, J. R. Greenwood, C. G. Cooper, and N. E. Simons.
Proceedings of the Institution of Civil Engineering, Vol. 76, p 207-220, February, 1984. 9 Fig, 7 Tab, 8 Ref.

Descriptors: *Embankments, *Embankment failures, Performance evaluation, Construction methods, Construction, Foundation failure, Structural engineering.

In June 1981, a 10 m high embankment constructed for the northern sector of the M25 orbital motorway failed shortly after completion of the bulk earthworks. The factor of safety calculated by conventional slip circle analysis in terms of total stress was in excess of 2 at the time of failure. The scope of the site investigations is set out, together with details of the analyses carried out; these lead

to various conclusions concerning the reasons for failure. To minimize disruption to the contract, remedial works had to be specified at various points in time. All of these aspects are examined in the context of the present state of technical knowledge, in order to derive lessons to be learned from the incident. The construction contract included several features which were departures from existing practice for embankment construction in clay soils. The drainage mat was placed on undisturbed ground, and had the secondary function of facilitating the movement of plant. A drainage mat can disguise the presence of a weak foundation which otherwise would rut under the movement of plant. One lesson is to limit the rate of placing. This has the additional benefit of precluding the use of large plant fleets of very high production rate. The final lesson is to use benching on sloping ground either laterally or longitudinally. Instabilities or weak zones which develop due to the weathering of soils tend to do so parallel to the ground surface. Benching neatly intersects these in manner which precludes the existence of extensive layers of weak strength immediately below an embankment. (Murphy-IVI)
W84-04203

FAILURE OF PORE-WATER ANALYSES FOR DISPERSION,
Bureau of Reclamation, Denver, CO.
C. D. Craft, and R. G. Acciardi.
Journal of Geotechnical Engineering, Vol. 110, No. 4, p 459-472, April, 1984. 5 Fig, 7 Tab, 10 Ref.

Descriptors: *Soil pore-water analysis, *Dispersion, *Soil porosity, Comparison studies, Performance evaluation, Soil properties, Soil engineering, Soil classification, Clayey soils, Analysis of variance.

Due to the potential loss to life and property resulting from catastrophic failure of earthen structures constructed with dispersive clay soils, there has been increasing interest in developing reliable physical and chemical tests to identify dispersive soils. The method of Sherard and coworkers ('currently accepted method') where soil saturation extract cation data are plotted on a percent sodium versus TDS (total dissolved solids in milliequivalents per liter) graph to classify clayey soils as dispersive or nondispersive, is applied to 223 soil samples from six different soil groups. The method exhibited poor overall agreement with physical test results. These data were subsequently evaluated using analysis of variance and discriminant analysis (a multivariate classification technique) which indicated that each soil group exhibits unique classification criteria based on pore-water cation data. It appears that, for most soil groups in this study, pore-water cation data do not provide adequate identification of dispersive and nondispersive clay soils. Reasons for the observed lack of agreement between pore-water data and physical tests are reviewed and suggestions for further research are presented. (Murphy-IVI)
W84-04601

8E. Rock Mechanics and Geology

ANTI-WEAR COATINGS OF THE RHONE DAMS (LES REVETEMENTS ANTI-USURE DES BARRAGES DU RHONE),
J. Mamet, N. Llopis, and A. D'Angelo.
La Houille Blanche, No. 3/4, 201-207, 1983. 6 Fig, 2 Tab, 1 Ref.

Descriptors: *Anti-wear coatings, *Coatings, *Rhone River, *Dams, Design criteria, Materials engineering, Concrete additives, Aprons, Piers, Resins.

Between 1952 and 1982, the National Company of the Rhone, in its development program for the river, built 16 reservoir dams equipped with sliding or sector gates. The aprons and piers are protected by anti-wear coatings. The granite rubble once used has given way to cement-corundum coatings which have in turn been replaced by synthetic resin coatings and concrete. Two types of protection were discovered and used for the first time at the Villeneuveles-Avignon dam. Epoxy-corundum tar pitch-resin coating has a thickness of 2 cm and is applied to a concrete surface which has undergone the necessary preparation. This compound is as resistant to wear as any high-grade granite. A resin-concrete coating is used in certain zones of dam aprons which are subject to vibrations or cavitation. The composition of this concrete is as resistant to wear as low-grade granite. Protection against impacts has also been examined. As a result, so-called simple formulations have been specified and their resistance to wear is mostly equivalent to that of soft steel. The least costly protection, epoxy-corundum tar pitch-resin coating plus resin concrete, adopted for the St-Pierre de Boeuf dam represents approximately 8% of the amount of civil engineering work of the facility. The diversification of the types of protection is specific to the design and operation of the mobile dams on the Rhone. The choice of the type of protection is subordinate to the parameters pertaining to each dam and the efficiency associated with the quality of the methods used for their construction and control. (Murphy-IVI)
W84-04216

EVALUATION OF THE RISK OF INDUCED SEISMICITY AT THE ITZANTUN HYDROELECTRIC SITE, CHIAPAS, MEXICO,
Alberta Univ., Edmonton. Dept. of Physics.
A. Uribe-Carvajal, and E. Nyland.
Engineering Geology, Vol. 19, No. 4, p 247-259, December, 1983. 7 Fig, 1 Tab, 33 Ref.

Descriptors: *Induced seismicity, *Dam effects, *Earthquakes, *Itzanrun, *Mexico, Reservoir filling, Drawdown, Geologic fractures, Thrust faulting, Hydroelectric plants, Tectonic stress.

Consolidation theory and concepts of rock failure can be used to evaluate the probable risk of induced seismicity as a result of filling of reservoirs. This evaluation indicates the safest way to fill a reservoir, and depends only on the geometry of the load, the rate of filling and the geological structures in the area. The stability function is actually a measure of the risk of having failure, with time, for a particular loading history in respect to a plane of weakness. The stability function is applied to the area of the Itantun reservoir, which will be in southern Mexico. Drawdowns can increase the risk of triggering earthquakes in this area, which is prone to thrust faulting. It is possible to estimate the stresses after a period during which the water level is maintained and a decrease in stresses with the depth of the observation point. The estimates of the probable induced seismicity are limited as the residual stress in the area prior to the impoundment is unknown. With a measure of the residual tectonic stress it will be possible to determine an optimal filling rate to reduce the probability of induced seismicity. (Author's abstract)
W84-04365

8F. Concrete

CALTRANS PRESTRESSED CONCRETE PIPE CULVERT RESEARCH: DESIGN SUMMARY AND IMPLEMENTATION,
A. E. Bacher, A. N. Banke, and D. E. Kirkland.
Transportation Research Record, No. 903, p 95-99, 1983. 16 Fig, 2 Ref.

Descriptors: *Design criteria, *Pipes, *Concrete, *Culverts, Prestressed concrete, Pressure pipes, Drainage, Earth load.

A summary of the design and implementation of a research project on the use of prestressed concrete pipe in culverts is presented. The research installation has 96-in prestressed concrete pipe culvert under 200 ft of overfill. The following design summary conclusions were made: Method A (compacted structure backfill) loadings of 140V:140H and 140V:42H are adequate; fill heights versus soil pressures were approximately linear; there was excellent correlation between theoretical and experimental moments, thrusts, and displacements; the 96-in prestressed pipe was grossly overdesigned; and earth load stresses are additive to those from prestressing. The primary use of prestressed pipe in the area has been for pressure pipe installations, specifically special drainage designs. Prestressed concrete continues to offer an acceptable alternative for special drainage designs, that is, where there is an unstable soil condition in a potential slide area. Under high fills it is not recommended, since there is admittedly the adverse effect of the earth loads being added to the prestressing forces. (Baker-IVI)
W84-04188

8G. Materials

EFFECT OF HEAVY LOADS ON BURIED CORRUGATED POLYETHYLENE PIPE,
R. K. Watkins, R. C. Reeve, and J. B. Goddard.
Transportation Research Record 903, p 99-108, 1983. 14 Fig, 4 Tab, 3 Ref.

Descriptors: *Corrugated polyethylene pipe, *Load distribution, Soil pressure, Pipes, Conveyance structures, Performance evaluation.

Corrugated polyethylene pipe, developed originally in 4- to 12-in diameters for land drainage, is now manufactured in larger diameters for other uses of buried conduits such as culverts, air ducts, and service conduits. Tests were conducted on pipes with 15-, 18- and 24-in inner diameter to investigate the structural performance and performance limits of these larger-diameter pipes when subjected to external soil pressures. For pipes in typical native soil backfill, compacted by typical methods to greater than 80 percent standard density (AASTHO T-99), less than 1 ft of soil cover (called minimum cover) was found to be adequate protection against H-20 (32-kip/axle) loads and up to 54-kip/axle 'super-loads'. The soil envelope does not have to be select material. At less than minimum cover, the performance limit is either (a) excessive pipe deflection or (b) localized reversal of curvature directly under the wheel load. Under high soil cover, both the performance and performance limit are pipe deflection (out-of-roundness), which is a function of the total vertical soil pressure and is equal to slightly less than vertical-soil strain in the backfill material on both sides of the pipe, herein referred to as sidefill. In compacted soil backfill, pipe deflection is less than 10 percent for either H-20 loads on minimum soil cover or vertical pressure up to 2500 psf under high soil cover. Pipe stiffness is roughly equal to steel and is greater than aluminum in 16-gage, 2-2/3 x 1/2 corrugations. (Author's abstract)
W84-04189

USE OF LINERS FOR CONTAINMENT AT HAZARDOUS WASTE LANDFILLS,
EMCON Associates, San Jose, CA.
F. Cope, G. Karpinski, J. Pacey, and L. Steiner.
Pollution Engineering, Vol. 16, No. 3, p 22-32, March, 1984. 3 Fig, 4 Tab, 15 Ref.

Descriptors: *Landfills, *Hazardous materials, *Linings, Design criteria, Legislation, Groundwater protection, Waste disposal, Economic aspects, Leachates, Water pollution prevention, Plastics, Polymers.

In spite of the growing interest in the use of synthetic liners to contain wastes, there is still some skepticism concerning their ability to protect groundwater over the long term. The pollution engineer must exercise considerable judgement in selecting and designing a liner system for a landfill, particularly a site designated to accept hazardous wastes. State-of-the-art design criteria are offered for liners at hazardous waste landfills. The necessary steps needed to meet the requirements for both natural and synthetic liners delineated in Subtitle C of the Resource Conservation and Recovery Act (RCRA) are noted. Selection of an appropriate liner should be based upon the performance required. Major selection criteria for liners include performance, waste compatibility, site conditions and environmental factors. Two critical pre-design activities that the designer must undertake are an assessment of the impact of waste composition on

liner selection, and an evaluation of site conditions that could impact liner performance. Landfill base liner systems should consist, at a minimum, of a primary liner of synthetic material, and a leachate collection and removal system. If final cover will not be applied for 30 years or more, the liner system is more complex, consisting of: primary liner of synthetic material; primary and secondary leachate detection, collection, and removal system; and a secondary liner of clay soil or synthetic material. Factors to be considered in estimating the capital costs of a lined hazardous waste unit include: type of liner material; location of facility; facility size; site conditions; and economic factors. (Baker-IVI)
W84-04201

ANTI-WEAR COATINGS OF THE RHONE DAMS (LES REVETEMENTS ANTI-USURE DES BARRAGES DU RHONE),
For primary bibliographic entry see Field 8E.
W84-04216

8I. Fisheries Engineering

A FISH POPULATION MODEL FOR IN-STREAM FLOW ASSESSMENT,
Pennsylvania State Univ., University Park. Dept. of Biology.
For primary bibliographic entry see Field 6G.
W84-04238

BABINE LAKE SOCKEYE SALMON (ONCORHYNCHUS NERKA) ENHANCEMENT PROGRAM: TESTING SOME MAJOR ASSUMPTIONS,
Department of Fisheries and Oceans, Nanaimo (British Columbia). Pacific Biological Station.
J. McDonald, and J. M. Hume.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 41, No. 1, p 70-92, January, 1984. 7 Fig, 20 Tab, 27 Ref, 1 Append.

Descriptors: *Babine Lake, *British Columbia, *Salmon, Fisheries engineering, Spawning channels, Flow control, Fish management.

The objective of the Babine Lake sockeye salmon (Oncorhynchus nerka) enhancement project was to increase fry outputs (and thus, smolt outputs and adult returns) by expandng and improving available spawning beds through the use of artificial spawning channels and related water flow control facilities. The project proceeded on four basic assumptions: (1) the artificial spawning channels would prove an effective means of producing sockeye fry, (2) the fry produced would be as viable as those produced from natural spawning beds, (3) the lake nursery area had the capacity to support larger juvenile populations, and (4) increased smolt outputs would result in increased adult returns. A before and after study has allowed these assumptions to be tested. Egg-to-fry survival in the channels was close to 40%, as expected. Comparisons of wild and channel-produced fry did not reveal any substantial difference in their distribution, growth, and survival in the lake. Increases in the abundance of fry were followed by corresponding increases in the abundance of underyearlings in the lake and seaward migrating smolts. No significant change in the average size of the juveniles or their survival in the lake could be detected when population size increased. While the assumptions regarding juvenile production were found to be generally valid, adult returns did not meet expectations. This was due largely to the lack of response to increased smolt outputs from even-numbered brood years. Some options for future management are offered. (Author's abstract)
W84-04761

10. SCIENTIFIC AND TECHNICAL INFORMATION

10B. Reference and Retrieval

INSTRUCTIONS FOR USING THE U.S. GEOLOGICAL SURVEY DATA BASE OF WELLS ON LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
G. W. Hawkins, and G. M. Terlecki.
USGS Open-File Report 82-568, 1983. 189 p, 16 Fig, 48 Tab, 2 Ref.

Descriptors: Algorithms, *Computer programs, *New York, Data collections, *Well data, Long Island, Minicomputers, FORTRAN programs.

The population of central and eastern Long Island, New York depends on ground water for its supply of fresh water. Data on more than 7,500 wells on the island have been collected by various State and local agencies and compiled by the U.S. Geological Survey since 1906. During 1975-81, the Geological Survey developed a data base for its Data General Nova 1220 minicomputer to store and process the well information. The data base is composed of seven sections, each of which may be revised and updated. Three types of magnetic devices with limited capacity are used for data storage--disk, Linctape, and 9-track tape. This breakdown makes each section small enough to store and update on a small minicomputer while allowing simultaneous data retrieval from all sections. This manual gives complete instructions for revising, storing, and retrieving well data. Most programming is in FORTRAN, but some is in assembly language. (USGS)
W84-04247

10C. Secondary Publication And Distribution

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN SOUTH DAKOTA, PROJECT STATUS SUMMARY, JULY 1, 1983,
Geological Survey, Helena, MT. Water Resources Div.
E. F. LeRoux, and E. M. Decker.
Available from the Ofss, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. USGS Open-file Report 83-754, July, 1983. 41 p, 3 Tabs.

Descriptors: Hydrologic data, *Water resources studies, Documentation, *South Dakota.

Project descriptions and lists of hydrologic-data stations are presented to show the status of the U.S. Geological Survey water-resources studies in South Dakota. (USGS)
W84-04241

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BARCELONA UNIV. (SPAIN). DEPT. OF ANALYTICAL CHEMISTRY.
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CENTRE D'ETUDES D'OCEANOGRAPHIE ET DE BIOLOGIE MARINE, ROSCOFF (FRANCE).
Hydraulic Factors and Phytoplankton in the Baie de Morlaix (Western English Channel) (Facteurs Hydrologiques et Phytoplancton en Baie de Morlaix (Manche Occidentale),
W84-04721 2L

CENTRE DE RECHERCHES EN PHYSIQUE DE L'ENVIRONNEMENT, ISSY-LES-MOULINEAUX (FRANCE).
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Calibration of a Meteorological Radar for Measuring Precipitation. Initial Results in the Paris Region (Calibration d'un Radar Meteorologique pour la Mesure des Precipitations. Premiers Resultats en Region Parisienne),
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CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE, TOULOUSE (FRANCE). INST. DE MECANIQUE DES FLUIDES.
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CENTRE OF INTERNATIONAL PROJECTS, MOSCOW (USSR).
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Stochastic Streamflow Models for Hydroelectric Systems,
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Inadequacy of Diversity Indices in Discerning Metal Mine Drainage Effects on a Stream Invertebrate Community,
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Computer Model for Moisture Distribution in Stratified Soils Under a Trickle Source,
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A Water Handbook for Metal Mining Operations,
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Turfgrass Evapotranspiration. II. Responses to Deficit Irrigation,
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COLORADO STATE UNIV., FORT COLLINS. DEPT. OF CHEMICAL ENGINEERING.
Optimizing Furrow Irrigation Runoff Recovery Systems,
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COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA (AUSTRALIA). DIV. OF PLANT INDUSTRY.
Dependence of Relationship Between Inherent and Apparent Optical Properties of Water on Solar Altitude,
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COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA (AUSTRALIA). DIV. OF WATER AND LAND RESOURCES.
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COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CRONULLA (AUSTRALIA). DIV. OF FISHERIES RESEARCH.
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Effect of Cropping, Summerfallow and Fertilizer Nitrogen on Nitrate-Nitrogen Lost by Leaching on a Brown Chernozemic Loam,
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DEPARTMENT OF FISHERIES AND OCEANS, NANAIMO (BRITISH COLUMBIA). PACIFIC BIOLOGICAL STATION.
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DEPARTMENT OF FISHERIES AND OCEANS, WINNIPEG (MANITOBA). FRESHWATER INST.
Fates of Metal Radiotracers Added to a Whole Lake: Accumulation in Slimy Sculpin (Cottus cognatus) and White Sucker (Catostomus commersoni),
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DHV CONSULTING ENGINEERS, AMERSFOORT (NETHERLANDS).
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Clam Burrowing Behaviour: Inhibition by Copper-Enriched Sediment,
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EAST BRABANT DEPT. OF TECHNOLOGY, BOXTEL (NETHERLANDS).
Phosphorus Removal in a Sewage Treatment Plant and Plant Biomass in an Effluent Receiving Lowland Stream,
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ECOLE NORMALE SUPERIEURE, PARIS (FRANCE). LAB. DE GEOLOGIE.
Lead Cycling in Estuaries, Illustrated by the Gironde Estuary, France,
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EDINBURGH UNIV. (SCOTLAND). DEPT. OF GEOLOGY.
Cadmium Adsorption in Freshwaters - A Quantitative Appraisal of the Literature,
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EDINBURGH UNIV. (SCOTLAND). GRANT INST. OF GEOLOGY.
A Versatile Computer-Controlled Tracking and Sampling System for Use with Model Lakes in Tall Tubes,
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Saint-Guillerme II. The Clapier Facilities (Reamenagement de la chute de Saint-Guillerme II Ouvrages du Clapier),
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Nakdong Estuary Barrage and Land Reclamation - Ecological Aspects,
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Planktonic Communities in Florida Softwater Lakes of Varying pH,
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Physiological Response of St. Augustinegrass to Irrigation Scheduling,
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Observations on the Use of Iron(III) Complexing Agents to Fractionate the Total Filterable Iron in Natural Water Samples,
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FRESHWATER BIOLOGICAL ASSOCIATION, WINDERMERE (ENGLAND).
Gas Chromatographic Determination of Total Amino Acids and Protein in Sediments Using the Ninhydrin-CO2 Reaction,
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FRESHWATER FISHERIES LAB., PITLOCHRY (SCOTLAND).
Fate and Distribution of the Mothproofing Agents Dieldrin and Eulan WA New in Loch Leven, Kinross, 1964-1979,
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GENERAL MOTORS RESEARCH LABS., WARREN, MI. ENVIRONMENTAL SCIENCE DEPT.
Retention and Release of Chemical Species by a Northern Michigan Snowpack,
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GENEVA UNIV. (SWITZERLAND). DEPT. OF GEOLOGY.
A Preliminary Investigation of the Rhone River Plume in Eastern Lake Geneva,
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GENOVA UNIV. (ITALY). IST. DI ZOOLOGIA.
Biochemical Effects of Long-Term Exposure to Cadmium and Copper on Rainbow Trout (Salmo gairdneri): Validation of Water Quality Criteria,
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GEOLOGICAL SURVEY, ATLANTA, GA.
Evaporation from Flowing Channels,
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Cost-Effectiveness of the Stream-Gaging Program in Maine,
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GEOLOGICAL SURVEY, BATON ROUGE, LA. WATER RESOURCES DIV.
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GEOLOGICAL SURVEY, CHEYENNE, WY. WATER RESOURCES DIV.
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GEOLOGICAL SURVEY, HARTFORD, CT. WATER RESOURCES DIV.
Water Resources Data, Montana, Water Year 1982: Volume 1. Hudson Bay and Missouri River Basins,
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Water Resources Data, Connecticut. Water Year 1982,
W84-04252 7C

GEOLOGICAL SURVEY, HELENA, MT. WATER RESOURCES DIV.
Water-Resources Investigations of the U.S. Geological Survey in South Dakota, Project Status Summary, July 1, 1983,
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Water Resources Data, Montana, Water Year 1982: Volume 2. Columbia River Basin,
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GEOLOGICAL SURVEY, INDIANAPOLIS, IN. WATER RESOURCES DIV.
Water and Streambed-Material Data, Eagle Creek Watershed, Indiana, August 1980, October and December 1982, and April 1983: Updating of U.S. Geological Survey Open-File Report 83-215,
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GEOLOGICAL SURVEY, JACKSON, MS. WATER RESOURCES DIV.
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Instructions for Using the U.S. Geological Survey Data Base of Wells on Long Island, New York,
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GEOLOGICAL SURVEY, TALLAHASSEE, FL. WATER RESOURCES DIV.
Source, Use, and Disposition of Water in Florida, 1980,
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MANITOBA UNIV., WINNIPEG. DEPT. OF CIVIL ENGINEERING.
Rainfall-elevation Relationships in the Wilson Creek Experimental Watershed,
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MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM, PLYMOUTH (ENGLAND).
Brown Seaweed, Fucus vesiculosus, and the Gastropod, Littorina littoralis, as Indicators of Trace-Metal Availability in Estuaries,
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MINISTERE DE L'HYDRAULIQUE, ALGIERS (ALGERIA). DIRECTION GENERALE DE L'EXPLOITATION.
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Fluoride Concentration in the Water of the River Cauvery, Karnataka, India,
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Liquid Chromatographic Determination of Ammonium in Water,
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, GREENBELT, MD. LAB. FOR ATMOSPHERIC SCIENCES.
Jakobshavns Glacier Drainage Basin: A Balance Assessment,
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NATIONAL ENVIRONMENTAL SATELLITE, DATA, AND INFORMATION SERVICE, WASHINGTON, DC. CLIMATE ASSESSMENT BRANCH.
The Weather of '83; A Year of Worldwide Extremes, Floods and Droughts,
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NATIONAL MARINE FISHERIES SERVICE, ANN ARBOR, MI. GREAT LAKES FISHERY LAB.
Decline of Mercury in Young Fishes from Western Lake Erie Between 1970-71 and 1974,
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NATIONAL MARINE FISHERIES SERVICE, LA JOLLA, CA. SOUTHWEST FISHERIES CENTER.
Power Plant Impact Assessment: A Simple Fishery Production Model Approach,
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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, ANN ARBOR, MI. GREAT LAKES ENVIRONMENTAL RESEARCH LAB.
Fate of Anthracene in an Artificial Stream: A Case Study,
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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, SEATTLE, WA. PACIFIC MARINE ENVIRONMENTAL LAB.
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Fungi and Bacteria Associated with Pine (Pinus kesiya Royle) Needles and Teak (Tectona grandis L.) Leaf Litters During Processing in a Freshwater Lake,
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NOTRE DAME UNIV., IN. DEPT. OF AEROSPACE AND MECHANICAL ENGINEERING.
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NOTTINGHAM UNIV. (ENGLAND). DEPT. OF ZOOLOGY.
Computer Storage and Evaluation of Water Quality Biological Data,
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OFFICE DE LA RECHERCHE SCIENTIFIQUE ET TECHNIQUE OUTRE-MER, PARIS (FRANCE).
Limnology of the River Bandama, Ivory Coast (Limnologie Du Fleuve Bandama, Cote d'Ivoire),
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OHIO RIVER VALLEY WATER SANITATION COMMISSION, CINCINNATI.
Controlling Discharges of Water Plant Wastes to the Ohio River,
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OKLAHOMA STATE UNIV., STILLWATER. DEPT. OF MICROBIOLOGY.
Size-Fractionation of Alkaline Phosphatase Activity in Lake Water by Membrane Filtration,
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OLD DOMINION UNIV., NORFOLK, VA. DEPT. OF OCEANOGRAPHY.
Dissolved Organic Matter and the Dissipation of Chlorine in Estuarine Water and Seawater,
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Bacterial Pollution from Agricultural Sources: A Review,
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OREGON STATE UNIV., CORVALLIS. DEPT. OF CIVIL ENGINEERING.
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Sediment Composition and Hydrography in Six High-Gradient Estuaries of the Northwestern United States,
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OTTAWA UNIV. (ONTARIO). DEPT. OF BIOLOGY.
Vitamin Enrichment of Lake Plankton: Field Tests of Micronutrient Limitation,
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PADUA UNIV. (ITALY). IST. DI IDRAULICA.
Optimal Diameters for Pressure Pipes of Hydro Plants,
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PARIS-11 UNIV., ORSAY (FRANCE). LAB. D'HYDROLOGIE ET DE GEOCHEMIE ISOTOPIQUE.
Environmental Isotope Content, Geochemistry and Genesis of Ice Lenses (Palsen) in New Quebec Peat Bogs (Canada) (Composition Isotopique, Geochimie et Genese de la Glace en Lentilles (Palsen) Dans les Tourbieres au Nouveau Quebec (Canada)),
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PARIS-6 UNIV. (FRANCE). LAB. DE GEOPHYSIQUE APPLIQUEE.
Natural Isotopic Composition of Nitrogen as a Tracer of Origin for Suspended Organic Matter in the Scheldt Estuary,
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PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. DEPT. OF BIOLOGY.
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PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. DEPT. OF CIVIL ENGINEERING.
Denitrification as a Mechanism for Nitrogen Removal in Aerobic Systems: Feasibility Analysis,
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PHILADELPHIA WATER DEPT., PA.
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Chemical and Toxicity Analysis of Leachates from Coal Conversion Solid Wastes,
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Influence of Cavitation on Noise in Modern Hydrostatic Circuits (Influence de la Cavitation sur le Bruit Dans Les Circuits Hydrostatiques Actuels),
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POLISH ACADEMY OF SCIENCES, LOMIANKI. INST. OF ECOLOGY.
The Effect of Phosphate on Bacterial Biomass Production in Waters of Lakes of the Jorka River Drainage Basin,
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POONA UNIV. (INDIA). DEPT. OF ZOOLOGY.
Effect of Sublethal and Lethal Concentrations of Fenitrothion, BHC and Carbofuran on Behaviour and Oxygen Consumption of the Freshwater Prawn Macrobrachium kistnensis (Tiwari),
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PRAGUE DEPT. OF WATER TECHNOLOGY (CZECHOSLOVAKIA).
Rotifers as Indicators of Water Quality,
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PRINCETON UNIV., NJ.
Geothermal Reservoir Simulation Using Nonequilibrium Thermodynamics,
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PRINCETON UNIV., NJ. DEPT. OF CIVIL ENGINEERING.
Groundwater Contaminant Transport Modeling,
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PURDUE UNIV., LAFAYETTE, IN. DEPT. OF AGRICULTURAL ECONOMICS.
Evaluation and Comparison of Two Methods for Characterization of Sediment Size Distribution,
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PURDUE UNIV., LAFAYETTE, IN. ENVIRONMENTAL ENGINEERING LAB.
Pentachlorophenol Biogradation-II; Anaerobic,
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QUEBEC UNIV., CHICOUTIMI. DEPT. DES SCIENCES FONDAMENTALES.
The Effects of Dredging on Sediments, Plankton and Fish in the Vauvert Area of Lake St. Jean, Quebec (Effet du dragage sur les sediments, le plancton et les poissons, dans la region de Vauvert au Lac St-Jean, Quebec),
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QUEBEC UNIV., RIMOUSKI. DEPT. OF OCEANOGRAPHY.
Temporal Occurrence of Ichthyoplankton in Relation to Hydrographic and Biological Variables at a Fixed Station in the St Lawrence Estuary,
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REXNORD, INC., MILWAUKEE, WI. ENVIROENERGY TECHNOLOGY CENTER.
Renovation of Steam Electric Power Plant Cooling Tower Blowdown for Non-Potable Reuse,
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RIJKSDIENST VOOR DE IJSSELMEERPOLDERS, LELYSTAD (NETHERLANDS).
Limnological Studies on the Eutrophication of Lake Wolderwijd, A Shallow Hypertrophic Oscillatoria Dominated Lake in the Netherlands,
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RIJKSINSTITUUT VOOR DRINKWATERVOORZIENING, LEIDSCHENDAM (NETHERLANDS). CHEMICAL BIOLOGICAL DIV.
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RIJKSINSTITUUT VOOR NATUURBEHEER, LEERSUM (NETHERLANDS).
The Haringvliet-Project: The Development of the Rhine-Meuse Estuary from Tidal Inlet to Stagnant Freshwater Lake,
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RIJKSWATERSTAAT-DELTADIENST, THE HAGUE (NETHERLANDS).
The Technical and Economic Aspects of the Water Separation System of the Krammer Locks,
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ROORKEE UNIV. (INDIA). DEPT. OF CIVIL ENGINEERING.
Use of Water Quality Index for River Classification and Zoning of Ganga River,
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ROSEVILLE PUBLIC WORKS DEPT., CA.
Use of Water Hyacinth Aquatic Treatment Systems for Ammonia Control and Effluent Polishing,
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SAINT DAVID'S UNIV. COLL., LAMPETER (WALES). DEPT. OF GEOGRAPHY.
Seasonal Changes in the Distribution of Rainfall Over the Great Dividing Range: General Trends,
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SAITAMA UNIV. (JAPAN). DEPT. OF FOUNDATION ENGINEERING.
Prediction of Alternate Bar Wavelength and Height,
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SALFORD UNIV. (ENGLAND). DEPT. OF MATHEMATICS.
Development and Application of 'U.S.E.D.': a Hydroclimate Lake Stratification Model,
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SASKATCHEWAN UNIV., SASKATOON. DEPT. OF BIOLOGY.
Limnological Studies of the Lakes and Streams of the Upper Qu'Appelle River System, Saskatchewan, Canada, II. Phytoplankton Primary Production and Algal Species Abundance and Occurrence,
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SAVANNAH RIVER ECOLOGY LAB., AIKEN, SC.
A Non-Equilibrium Approach to Modeling Metal Speciation in Acid, Aquatic Systems: Theory and Process Equations,
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SCIENCE AND EDUCATION ADMINISTRATION, OXFORD, MS. SEDIMENTATION LAB.
Soil Erodibility Variation During the Year,
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SCIENCE UNIV. OF TOKYO. (JAPAN). FACULTY OF PHARMACEUTICAL SCIENCES.
In vitro Cholinesterase Inhibition of Organic Matter in Urban and Rural River Sediment,
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SERVICE HYDROLOGIQUE CENTRALISATEUR DU BASSIN DE LA GARONNE, TOULOUSE (FRANCE).
The Use of Radar for Flood Warning and Forecasting in the Critical Basins of the Vezere and Correze (Le Radar et la Pluie. Application a l'Announce et a la Prevision des Crues dans les Bassins Critiques de la Vezere et de la Correze),
W84-04647 2B

SERVICE METEOROLOGIQUE METROPOLITAIN, LE BOURGET (FRANCE).
The Use of Radar as an Aid to Quantitative Estimation of Precipitation. Forecasting Sudden Floods in Martinique (Le Radar Comme Aide a l'Estimation Quantitative des Precipitations. Prevision des Crues Eclairs en Martinique),
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SEVERN-TRENT WATER AUTHORITY, BIRMINGHAM (ENGLAND).
The Influence of Drought on the Fish and Invertebrate Populations of an Upland Stream in Wales,
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SIKA FINANZ A.G., BAAR (SWITZERLAND).
Contribution to the Study of the Protection Against Abrasion and Impacts Affecting Hydro-Electric Facilities (Contribution a l'Etude de la Protection Contre l'Abrasion et les Chocs des Ouvrages Hydrauliques),
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SLOVENSKA AKADEMIA VIED, BRATISLAVA (CZECHOSLOVAKIA). USTAV EXPERIMENTALENJ BIOLOGIE A EKOLOGIE.
Water Relations Pattern of Understorey Species Influenced by Sunflecks,
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SLOVENSKA AKADEMIE VIED, BRATISLAVA (CZECHOSLOVAKIA). USTAV HYDROLOGIE A HYDRAULIKY.
Relationship Between Soil Moisture and Leaf Water Potential of Three Forest Tree Species,
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SMITHSONIAN INSTITUTION, EDGEWATER, MD. CHESAPEAKE BAY CENTER FOR ENVIRONMENTAL STUDIES.
Nutrient Flux in the Rhode River: Tidal Exchange of Nutrients by Brackish Marshes,
W84-04367 2L

Nutrient Flux in the Rhode River: Tidal Transport of Microorganisms in Brackish Marshes,
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SOIL CONSERVATION SERVICE, WEST WARWICK, RI.
Deposition of Nonuniform Sediment on Concave Slopes,
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SOUTH CAROLINA AGRICULTURAL EXPERIMENT STATION, CLEMSON.
Water Table Depth Interaction with Nitrogen Rates on Subirrigated Corn,
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SOUTH CAROLINA WILDLIFE AND MARINE RESOURCES DEPT., CHARLESTON. MARINE RESOURCES RESEARCH INST.
Effects of Dredging and Open-Water Disposal on Benthic Macroinvertebrates in a South Carolina Estuary,
W84-04670 5C

SOUTH DAKOTA COOPERATIVE FISHERY RESEARCH UNIT, BROOKINGS.
Food of Bluegills (Lepomis macrochirus) from Heated and Unheated Areas of a Power Plant Cooling Reservoir,
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SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY, RAPID CITY. DEPT. OF CIVIL ENGINEERING.
Experience in Monitoring Domestic Water Sources and Process Waters for Trace Organics,
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SOUTHERN ILLINOIS UNIV. AT CARBONDALE. DEPT. OF GEOGRAPHY.
Water Conservation: The Struggle Over Definition,
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SOUTHERN WATER AUTHORITY, WORTHING (ENGLAND). RESOURCES SECTION.
Borehole Recharge of the Folkestone Beds at Hardham, Sussex, 1980-81,
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STANFORD UNIV., CA. DEPT. OF CIVIL ENGINEERING.
Organic Contaminant Behavior During Rapid Infiltration of Secondary Wastewater at the Phoenix 23rd Avenue Project,
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STATE UNIV. OF NEW YORK AT BINGHAMTON. DEPT. OF GEOLOGICAL SCIENCES.
Bed Load Grain Velocities and Sediment Transport Rates,
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STATE UNIV. OF NEW YORK AT BUFFALO, AMHERST. DEPT. OF CHEMICAL ENGINEERING.
An Experimental Study of the Complete-Mixing Model for Radial Flow Hollow Fiber Reverse Osmosis Systems,
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STATE UNIV. OF NEW YORK AT BUFFALO. DEPT. OF CHEMICAL ENGINEERING.
A Note on Fluoride Removal by Reverse Osmosis,
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STATE UNIV. OF NEW YORK AT BUFFALO. DEPT. OF GEOGRAPHY.
Link Length Distributions in Drainage Networks With Lakes,
W84-04569 2E

STATE UNIV. OF NEW YORK COLL. OF ENVIRONMENTAL SCIENCE AND FORESTRY, SYRACUSE. SCHOOL OF LANDSCAPE ARCHITECTURE.
2,3,6-Trichlorophenylacetic Acid (Fenac) Degradation in Aqueous and Soil Systems,
W84-04543 5B

STATION BIOLOGIQUE DE LA TOUR DU VALAT, ARLES (FRANCE).
Algal Bioassays and Algal Growth Controlling Factors in Eutrophic Shallow Lakes,
W84-04684 2H

STOCKPORT METROPOLITAN BOROUGH COUNCIL, CHESTER (ENGLAND). ENVIRONMENTAL HEALTH DEPT.
A Bacteriological Assessment of the Mersey Estuary and North Wirral Coast, UK,
W84-04561 5B

SWEDISH WATER AND AIR POLLUTION RESEARCH LAB., GOETEBORG.
Bacterioplankton in the Acidified Lake Gardsjon,
W84-04701 5C

TECHNION - ISRAEL INST. OF TECH., HAIFA.
Preventing Haloform Formation in Treated Surface Water: A Case Study,
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TECHNION - ISRAEL INST. OF TECH., HAIFA. FACULTY OF CIVIL ENGINEERING.
Optimal Annual Operation of a Coastal Aquifer,
W84-04567 4B

TECHNISCHE UNIV., DRESDEN (GERMAN D.R.). BEREICH HYDROBIOLOGIE.
Problems of Water Demand According to Volume and Quality for the Production of Young Fish (Probleme des Wasserbedarfs nach Menge und Gute fur die Satzfischproduktion),
W84-04790 6D

TECHNISCHE UNIV., HAMBURG (GERMANY, F.R.).
Chemical Extraction of Heavy Metals in Polluted River Sediments in Central Europe,
W84-04741 5A

TENNESSEE UNIV., KNOXVILLE. COLL. OF ENGINEERING.
Purgeable Organics in Tennessee Groundwaters: A Problem Assessment,
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TENNESSEE UNIV., KNOXVILLE. DEPT. OF AGRICULTURAL ENGINEERING.
Uniformity Design Criteria under Limited Water,
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TENNESSEE VALLEY AUTHORITY, KNOXVILLE.
Influence of Livestock on Nonpoint Source Nutrient Levels of Streams,
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TEXAS A AND M UNIV., COLLEGE STATION. DEPT. OF AGRICULTURAL ENGINEERING.
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TEXAS AGRICULTURAL EXPERIMENT STATION, LUBBOCK.
LEPA Irrigation System Evaluation,
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TEXAS UNIV. AT AUSTIN. CENTER FOR RESEARCH IN WATER RESOURCES.
Development and Application of Models for Planning Optimal Water Reuse,
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TEXAS UNIV. AT AUSTIN, PORT ARANSAS. MARINE SCIENCE INST.
Benthic Nutrient Regeneration in South Texas Coastal Waters,
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THESSALONIKI UNIV., SALONIKA (GREECE). SCHOOL OF TECHNOLOGY.
Nonlinear Diffusion with Linearly Varying Diffusivity,
W84-04307 2F

TIKHOOKEANSKII NAUCHNO-ISSLEDOVATEL'SKII INST. RYBNOGO KHOZYAISTAVA I OKEANOGRAFII, VLADIVOSTOK (USSR).
Zooplankton and Feeding of Young Fish in the Zone of Discharge of Effluents from the Tripol'ye Power Plant,
W84-04731 5C

TOKYO METROPOLITAN RESEARCH INST. FOR ENVIRONMENTAL PROTECTION (JAPAN).
Measurements of the Concentration in Rainwater and of the Henry's Law Constant of Hydrogen Peroxide,
W84-04537 5A

TOKYO UNIV. (JAPAN). BIOCHEMICAL ENGINEERING LAB.
The Role of Tides in Removing Phosphorus from Lake Nakanoumi, a Coastal Lagoon in Japan,
W84-04753 2L

TOKYO UNIV. (JAPAN). INST. OF APPLIED MICROBIOLOGY.
Nakanoumi Land Reclamation and Freshening Project,
W84-04502 6G

TORONTO UNIV. (ONTARIO). DEPT. OF GEOGRAPHY.
Solute Release and Sediment Entrainment on Microcatchments in the Dinosaur Park Badlands, Alberta, Canada,
W84-04302 2J

TOULOUSE-3 UNIV. (FRANCE). LAB. D'AEROLOGIE.
The Use of Radar for Hydrological Measurements (Mesures Hydrologiques par Radar),
W84-04645 2B

TUEBINGEN UNIV. (GERMANY, F.R.). INST. FUER CHEMISCHE PFLANZENPHYSIOLOGIE.
Dynamics of the Volatile Organic Substances Associated with Cyanobacteria and Algae in a Eutrophic Shallow Lake,
W84-04541 2H

UMEA UNIV. (SWEDEN). DEPT. OF INORGANIC CHEMISTRY.
Equilibrium Approaches to Natural Water Systems - Part 3,
W84-04400 2H

UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION, BERLIN (GERMAN D.R.). INTERNATIONAL HYDROLOGICAL PROGRAMME.
Results of the UNESCO International Hydrological Program (Ergebnisse des Internationalen Hydrologischen Programms der UNESCO),
W84-04782 2A

UNITED STATES ECOLOGY, INC., LOUISVILLE, KY.
Geohydrology of Industrial Waste Disposal Site,
W84-04492 5E

UNIVERSIDAD CAOLICA DE CHILE, SANTIAGO. FACULTAD DE CIENCIAS BIOLOGICAS.
Environmental Impact in Sandy Beaches of Copper Mine Tailings at Chanaral, Chile,
W84-04331 5C

UNIVERSIDADE FEDERAL DE SAO CARLOS (BRAZIL). LAB. OF LIMNOLOGY.
A Review of Basic Ecological Processes Interacting with Production and Standing-Stock of Phytoplankton in Lakes and Reservoirs in Brazil,
W84-04691 2H

UNIVERSIDADE FEDERAL DO MARANHAO, SAO LUIS (BRAZIL).
Relationships Among Catches, Fishing Effort and River Morphology for Eight Rivers in Amazonas State (Brazil), During 1976-1978,
W84-04272 2H

UNIVERSITE CATHOLIQUE DE LOUVAIN, LOUVAIN-LA-NEUVE (BELGIUM).
Effects of Wind Velocity on Stomatal Conductance and Consequences of Leaf Rolling on Water Uptake in Tall Fescue,
W84-04774 2I

UNIVERSITY COLL., CARDIFF (WALES). DEPT. OF PLANT SCIENCE.
Battery Operated Incubator for in situ Primary Productivity Studies in Small Lakes and Rivers,
W84-04715 7B

UNIVERSITY COLL. OF NORTH WALES, BANGOR. SCHOOL OF PLANT BIOLOGY.
The Ecology of Epipelic Algae of Five Welsh Lakes, With Special Reference To Volvocalean Green Flagellates (Chlorophyceae),
W84-04322 2H

UNIVERSITY OF STRATHCLYDE, GLASGOW (SCOTLAND). DEPT. OF CIVIL ENGINEERING.
Dynamic Behaviour of Safety Butterfly Valves,
W84-04666 8C

UNIVERSITY OF STRATHCLYDE, GLASGOW (SCOTLAND). DEPT. OF THERMODYNAMICS AND FLUID MECHANICS.
Bulk Water Flow to Power Marine Beacons,
W84-04487 8C

UPPSALA UNIV. (SWEDEN). DEPT. OF HYDROLOGY.
Dissolved Inorganic Substances, A Study of Mass Balance in Three Small Drainage Basins,
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NORTH AMERICAN CONTINENT PRICE SCHEDULE

Customers in Canada, United States, and Mexico please use this price schedule; other addressees, write for Folder PR-360-4.

MICROFICHE					
A01	$4.50	E01	$6.50	T01	$125.00
PAPER COPY		E02	7.50	T02	140.00
A02	7.00	E03	9.50	T03	240.00
A03	8.50	E04	11.50	T04	320.00
A04	10.00	E05	13.50	T05	400.00
A05	11.50	E06	15.50	T06	465.00
A06	13.00	E07	17.50	T07	530.00
A07	14.50	E08	19.50	T08	595.00
A08	16.00	E09	21.50	T09	660.00
A09	17.50	E10	23.50	T10	725.00
A10	19.00	E11	25.50	T11	790.00
A11	20.50	E12	28.50	T12	855.00
A12	22.00	E13	31.50	T13	920.00
A13	23.50	E14	34.50	T14	985.00
A14	25.00	E15	37.50	T15	1,050.00
A15	26.50	E16	40.50	T16	1,115.00
A16	28.00	E17	43.50	T17	1,180.00
A17	29.50	E18	46.50	T18	1,245.00
A18	31.00	E19	51.50	T19	1,310.00
A19	32.50	E20	61.50	T99	**
A20	34.00	E99	**		
A21	35.50	N01	35.00		
A22	37.00	N02	40.00		
A23	38.50				
A24	40.00	*Add $1.50 for each additional 25-page increment, or portion thereof.			
A25	41.50	**Contact NTIS for price quote.			
A99	*				

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